MINISTRY OF ENVIRONMENT AND WATER

EXECUTIVE ENVIRONMENT AGENCY

NATIONAL INVENTORY REPORT 2008

For Bulgarian Greenhouse Gas Emissions

Submission under the UN Framework Convention on Climate Change (UNFCCC)
and the Kyoto Protocol

Sofia, 2008

Reporting entity

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ABBREVIATION'S LIST

CH_4	Methane
CO	Carbon oxide
CO_2	Carbon dioxide
CO_2-eq.	Carbon dioxide-equivalent
CORINAIR	The Atmospheric Emission Inventory for Europe
CRF	Common Reporting Format
DOC	Degradable Organic Content
EEA	Executive Environment Agency
EPA	Environmental Protection Act
EUROSTAT	European Statistical Organization
FAO	Food and Agriculture Organization
GHG	Greenhouse Gas
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel of Climate Change
KP	Kyoto Protocol
LPG	Liquid Petroleum Gas
LULUCF	Land Use and Land Use Change and Forestry
MAFS	Ministry of Agriculture and Food Supply
MEE	Ministry of Economy and Energy
MIA	Ministry of Internal Affairs
MoEW	Ministry of Environment and Water
MOI	Ministry of Interior
MSW	Municipal Solid Waste
N_2O	Nitrous oxide
NC	National Communication
NFPS	National Forest policy and strategy
NIR	National Inventory Report
NMVOCs	Non-Methane Volatile Organic Compounds
NOx	Nitrogen oxide
NPP	Nuclear Power Plant
NSI	National Statistical Institute
OECD	Organization for Economic Cooperation and Development
PFC	Perfluorocarbons
QA/QC	Systems for Quality Assessment and Quality Control
QMS	Quality Management System
RA	Reference Approach
RCD	Road Control Department
SA	Sectoral Approach
SBSTA	Subsidiary Body for Scientific and Technological Advice
SFA	State Forestry Agency
SF_6	Sulphur hexafluoride
SOx	Sulphur oxide
SWDS	Solid Waste Disposal Site
TPP	Thermo Power Plant
UNFCCC	UN Framework Convention on Climate Change

EXECUTIVE SUMMARY

Background Information on GHG Inventories and Climate Change

This Report documents the annual GHG inventory in Bulgaria for 2006 in accordance with the UN Framework Convention on Climate Change and the Kyoto Protocol, which has been prepared in conformity with UNFCCC Guidelines, adopted at the 21^{-st} session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), on 06-14 December 2004 in Buenos Aires. The Guidelines set up the structure of National GHG Inventory Report, prepared in compliance with the Revised 1996 IPCC Guidelines, and the IPCC Good Practice Guidance for National GHG Inventories, 2000.

According to the UNFCCC Guidelines, the inventory should have features, which are also elements of the "good practice", and provide

- Transparency;
- Consistency;
- Comparability;
- Completeness;
- Accuracy.

In view of that, this Report presented also the GHG emission trends for the period 1988-2006. The following are described as well:

1. Methods and indices for uncertainty assessment of the annual GHG emissions and trends;
2. Key GHG emission sources according to method of the type Tier 1, specified in the Good Practice Guidance;
3. Assessment of the quality assurance and control system.

Tables with GHG data and emissions generated by the software of **UNFCCC - CRF Reporter**, which automates the process of making and printing the CRF-tables for the Common Reporting Format (CRF) for reporting the annual inventories, are submitted together with the Report. These tables were completed for the whole period 1988-2006.

The CRF Tables and the text of the National inventory report as a PDF – file, have been uploaded on the web page of ExEA under the MoEW - http://nfp-bg.eionet.eu.int/ncesd/bul/UNFCCC/2002/home.html.

UNFCCC and the Kyoto Protocol

The Parliament ratified the UNFCCC in March 1995.

The Convention divided the Parties into two main groups: those, listed in Annex 1 (known as Annex I Parties), and those, not listed in this Annex I. The Annex I Parties amount to 41. These are the industrial countries of the world, members of the Organization for Economic Cooperation and Development (OECD), and the countries with economy in transition (Russia, Baltic countries, Ukraine and the Central and East European countries). Bulgaria is a part of the group of the East European countries with economy in transition.

The Kyoto Protocol (KP) is adopted at the III^{-rd} Session of the Conference of the Parties to the Convention in December 1997, in Kyoto, Japan. KP is ratified by Bulgaria on 15 August 2002. After Russia ratified the KP in November 2004, it entered into force on 16 February 2005.

With the KP, the Parties to the Convention took the commitment not only to stabilize the GHGs emissions, but also to reduce them by percentage, defined with respect to the base year of each Party. Bulgaria took the commitment to reduce the GHGs emissions from its base year, 1988, by 8 % for the first commitment period pursuant to the Protocol (2008-2012)

Requirements to the Reports: UNFCCC and KP

Annex I Parties to the Convention should report the annual GHG inventory, where should be included data for the GHG emissions of the base year and at least one year, preceding the current inventory.

Annex I Parties to the Kyoto Protocol should report also additional elements as assigned amount information, changes in national system, changes in national registry and voluntary submission of information relating to activities under Articles3, paragraphs 3 and 4, of the Kyoto Protocol.

Since 2000, the annual inventories were subject of technical checks. Further to the above mentioned, the Annex I Parties should submit also National Communications on Climate Change, where an overall picture of the activity on Climate Change is given and measures and policies regarding reduction of GHG emissions for a certain prognosticated period are indicated. Bulgaria submitted its IV^{-th} National communication in August 2006.

Description of the Institutional Arrangement for Inventory Preparation

Bulgaria's reporting obligations to the UNFCCC, UNECE and EC are administered by the Ministry of Environment and Water /MoEW/.

Single national entity with the responsibility for preparation of Bulgaria's National GHG Inventory is Executive Environment Agency.

The Bulgarian National System of Greenhouse Gas Inventory is created according to the requirements of Article 5, paragraph 1, of the Kyoto Protocol and the Marrakech Accord (respective Decision 20/CP.7).

The legal basis for the Bulgarian National System of Greenhouse Gas Inventory is provided in the **Environmental Protection Act** /EPA/ (State Gazette №91/2002) and in particular by the provisions of it's Chapter 8, which establishes the National Environmental Monitoring System and lists all of its tasks.

The Executive Environment Agency (EEA) coordinates all activities, related to collecting data on fuels and other sources of GHG emissions. EEA is the core body for collecting inventory data, aggregated on a national level by the following state authorities:

- National Statistical Institute (NSI);
- Road Control Department (RCD) within the Ministry of Internal Affairs;
- Statistics Department within Ministry of Agriculture and Food Supply (MAFS);
- Ministry of Economy and Energy (MEE);
- Ministry of Environment and Water (MoEW);
- State Forestry Agency (SFA);

- Soil Resource Executive Agency within MAF;
- National Service for Plant Protection, Quarantine and Agro chemistry;
- Energy Efficiency Agency (EEA).

The NSI plays a special role in data collection system for the inventory. Data for energy and material balances of the country, as well as major part of the calculations on the national inventory under the CORINAIR methodology are prepared in NSI. All data, related to solid waste and wastewater, is also collected there.

NSI uses up-to-date statistical methods and procedures for data summarizing and structuring, harmonized with the provisions and methods of EUROSTAT.

The GHG inventory used data, received directly from large GHG emissions sources in the energy sector and the industry and this data is summarized by EEA.

Description of Key Categories

The identification of key source categories is described in the IPCC Good Practice Guidance, 2000. A key source category is one that is prioritised within the National System because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both.

The identification includes all reported greenhouse gases CO_2, CH_4, N_2O, HFC, PFC and SF_6, and all IPCC source categories, except LULUCF. The results of a key category analysis including emissions and removals from LULUCF are included in Annex 1.

Organization of the National Inventory Report

The organization of the inventory report of Bulgaria for 2006, and the corresponding National report have been improved compared to the preceding National report, 2005, as follows:

- In sector Solvent and Other Product Use were calculated emissions of CO_2 and N_2O during the whole time-series;
- In sector Waste was made considerable changes of data and emission factors, which were introduced in chapter "Recalculations" of this report.

National Inventory Report starts with **Chapter 1** – Introduction, which includes general information for the process of elaboration of the GHG Inventory in Bulgaria, description of the key sources of GHG emissions, assessment of the methods, sources and emission factors as well as the uncertainty in their determination.

In **Chapter 2** the GHG trends by type of sources and gases are analyzed.

Chapters 3–9 provide information in detail of the GHG emissions from the different sectors of the economy and services.

The final **Chapter 10** presents information and results from GHG emissions recalculations done for the period 1988-2005.

There are seven appendixes in the report, which give detailed assessment of the used data, and the received results.

CHAPTER 1 INTRODUCTION

The Republic of Bulgaria joined the UN Framework Convention on Climate Change (UNFCCC), which took part in Rio de Janeiro in 1992. The Parliament ratified the UNFCCC in March 1995.

As an Annex I Party to the Convention, Bulgaria is committed to conduct annual inventories on greenhouse gas (GHG) emissions by sources and removals by sinks, using the GHG inventory methodology, approved by the UNFCCC.

The inventories issuance started with the country base year – 1988. The first inventories covered the period 1988-1994 as a part of the international project "Country Study to Address Climate Change".

1.1. Background Information on GHG Inventories and Climate Change

This Report documents the annual GHG inventory in Bulgaria for 2006 in accordance with the UN Framework Convention on Climate Change and the Kyoto Protocol, which has been prepared in conformity with UNFCCC Guidelines, adopted at the 21^{-st} session of the Subsidiary Body for Scientific and Technological Advice (SBSTA), on 06-14 December 2004 in Buenos Aires. The Guidelines set up the structure of National GHG Inventory Report, prepared in compliance with the Revised 1996 IPCC Guidelines, and the IPCC Good Practice Guidance for National GHG Inventories, 2000.

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1.1.1. Greenhouse Gases and Climate Change: Global Warming Potential (GWP).

The main greenhouse gases to be reported pursuant to UNFCCC are as follows:

- Carbon dioxide - CO_2;
- Methane - CH_4;
- Nitrous oxide - N_2O;
- Hydrofluorocarbons – HFCs;
- Perfluorocarbons – PFCs;
- Sulphur hexafluoride - SF_6.

Each of these gases has a different warming effect. As an example, the gases HFCs, PFCs and SF_6 (so called F-gases) have much greater warming effect, in some cases over one hundred times, compared to methane, nitrous oxide and carbon dioxide.

Because of that, a common assessment criterion for the effect of each GHG on the atmosphere warming should be introduced. This criterion is the so-called Global Warming Potential (GWP), representing GHG emissions as CO_2-eq. emissions. It allows totalling the effect of all GHGs, adjusted to a common base.

For defining of GWP, the Parties to the Convention and Kyoto Protocol accept values, over a time horizon of 100 years, as mentioned in the IPCC Second Assessment Report of 1999.

Other gases have indirect warming effect to the atmosphere (as NOx, CO and NMVOCs), or cooling effect as SOx. These gases are precursors of the greenhouse gas – troposphere ozone, and are subject of regional control protocols. They do not have global effect on the climate changes as the main GHG. That is why in the National Inventory Report only the total GHGs emissions – precursors, as well as the total SOx emissions were reported.

1.1.2. UNFCCC and the Kyoto Protocol

The UN Framework Convention on Climate Change is proposed for signing by the world commonwealth at the World Summit in 1992 in Rio de Janeiro. Bulgaria participated in that international forum and joined the Convention.

The Parliament ratified the UNFCCC in March 1995.

The Convention set as an ultimate objective the stabilization of the atmospheric GHGs concentration at levels, not allowing dangerous anthropogenic effects on the climate system. These levels must be achieved for a period, allowing the ecosystems to adapt in a natural way to the climate change.

The Convention divided the Parties into two main groups: those, listed in Annex 1 (known as Annex I Parties), and those, not listed in this Annex I. The Annex I Parties amount to 41. These are the industrial countries of the world, members of the Organization for Economic Cooperation and Development (OECD), and the countries with economy in transition (Russia, Baltic countries, Ukraine and the Central and East European countries). Bulgaria is a part of the group of the East European countries with economy in transition.

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1.1.3. Requirements to the Reports: UNFCCC and KP

Annex I Parties to the Convention should report the annual GHG inventory, where should be included data for the GHG emissions of the base year and at least one year, preceding the current inventory.

Annex I Parties to the Kyoto Protocol should report also additional elements as assigned amount information, changes in national system, changes in national registry and voluntary submission of information relating to activities under Articles3, paragraphs 3 and 4, of the Kyoto Protocol.

Since 2000, the annual inventories were subject of technical checks. Further to the above mentioned, the Annex I Parties should submit also National Communications on Climate Change, where an overall picture of the activity on Climate Change is given and measures and policies regarding reduction of GHG emissions for a certain prognosticated period are indicated. Bulgaria submitted its IV^{-th} National communication in August 2006.

UNFCCC

The UNFCCC Guidelines describes the GHG emission sources, the methods of their calculation and the content of the inventory reports. For obtaining, the results from GHGs emissions' calculations, the Revised 1996 IPCC Guidelines, the 2000 IPCC Good Practice Guidance and Good Practice Guidance for LULUCF, should be used in general.

The tables of the Common Reporting Format (CRF) and the National inventory report are the two main documents, which report the annual consecutive inventories to Secretariat to the Convention. The Parties are obliged to publish the inventories on a paper carrier or in e-format on an Internet web page.

IPCC

The IPCC methodology uses the concept of application of methods with a different complexity, describing the processes for estimating the input data, emission factors and GHG emissions. The complexity level of the method is indicated by Tier X, as the higher "X" is, the more complex the method is. For example:

- Tier 1 is the simplest method, requiring minimum data and no complex processes models;
- Tier 2 is more complex and requires more input data and more complex models;
- Tier 3 is the most accurate method.

It is necessary to have a reasonable and balanced combination of the method accuracy with the type and accuracy of the results obtained, as well as with the capabilities of the Party to provide the relevant information data and resources. The regulation of this balance is covered by the Good Practice Guidance, which gives the ways for optimal combining of results' accuracy and the capabilities of those, who prepare the inventory. The leading concept of this combination is the rule for using methods that are more accurate for the key sources of GHG emissions, on a first place.

1.1.4. Differences with the National Inventory

UNFCCC uses certain definitions regarding the structure of the emissions, which have to be included in the total emissions of the country.

As a whole, the results obtained by the IPCC methods differ from the results of the National inventory, which is carried out in compliance with the method CORINAIR of EU. It concerns mostly the GHG emissions – precursors.

The reasons for that difference have both methodical and structural origin. There are also certain differences in the quantity of the input data, used for calculating the emissions of combustible and technological processes. Unlike the CORINAIR methodology, IPCC methodology does not take into account the CO_2 emissions from biomass combustion, because the net biomass emissions are zero. In the last several inventories, a process of decrease in these differences observes, mainly because of removal of differences in data and emission factors. It could be claimed that the differences have decreased more than twice, compared to Inventory 2000.

1.1.5. Organization of the National Inventory Report

The organization of the inventory report of Bulgaria for 2006, and the corresponding National report have been improved compared to the preceding National report, 2005, as follows:

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1.2. A description of the Institutional Arrangement for Inventory Preparation

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Legal basis of the Bulgarian National Inventory System

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The legal basis for the Bulgarian National System of Greenhouse Gas Inventory is provided in the **Environmental Protection Act** /EPA/ (State Gazette №91/2002) and in particular by the provisions of it's Chapter 8, which establishes the National Environmental Monitoring System and lists all of its tasks.

To ensure the effective and timely functioning of the Bulgarian National System of Greenhouse Gas Inventory, as well as complete reporting under the UN Framework Convention on Climate Change (UNFCCC) and the Convention of Long-Range Transboundary Air Pollution (CLRTAP), the Minister of Environment and Water has issued the **Order № RD-54/25.01.2007**, based on the EPA, which regulate in detail the institutional, legal and procedural arrangements and responsibilities for inventory preparation under the Secretariats of UNFCCC and CLRTAP.

In additional, on the basis of Article 4 from the Council of Ministers Regulation on the organization of activities with regard to preparation and presentation of reports to the European Commission on the implementation of the legislative acts, which are part from the European Community legislation in the field of environmental protection (State Gazette №43/2007), as well in accordance with Chapter III.2 of the above mentioned Order, is established an **Order № RD-377/08.06.2007** by the Minister of Environment and Water, which determines the following:

1. Procedures and requirements for reporting to the European Commission and the European Environment Agency;
2. Timely performance of all activities concerning the preparation of national greenhouse gas inventory and relevant national report, according to:
    2.1. Decision №280/2004/EC of the European Parliament and the Council of 11 February 2004 concerning a mechanism for the monitoring of Community greenhouse gas emissions and for implementing the Kyoto Protocol and;
    2.2. Commission Decision of 10 February 2005 laying down rules for the implementation of Decision №280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (166/2005/EC).

Besides the EPA there are other legal and institutional arrangements and agreements in place as basis for the Bulgarian National System of Greenhouse Gas Inventory:

- **National Statistics Act** - according to it the National Statistical Institute (NSI) has to prepare annually national material and energy balances, which are the data basis for calculating the GHG emissions from sectors Energy and Industrial Processes. NSI has a number of **internal regulations**, which determine the responsibilities of its departments, including their responsibilities with regard to data quality control.
- The National Statistical Institute has an **official agreement (RD21-25/30.01.2003)** with the Ministry of Environment and Water on provision and exchange of statistical and environmental information. Based on this Agreement the ExEA has the possibility to obtain confidential data from NSI for it's reporting obligations. In addition, the National Statistics Act allows NSI to provide confidential data to authorities (MoEW, ExEA etc.) that have a legal obligation for the (confidential) processing of these data.

In consequence of the above mentioned orders, all institutional and procedural options of Bulgarian National System of Greenhouse Gas Inventory are determined, ensuring the effective functioning in accordance with the requirements of Article 5.1 of the Kyoto Protocol, as well as the relevant requirement of EU.

National Registry

The establishment of the National Registry accounting the greenhouse gas emissions is an obligatory requirement under the Kyoto Protocol.

Bulgaria started to set up the national registry in compliance with the basic registry requirements as well as with the requirements for the EU ETS registries as elaborated by the European Commission and presented in Commission Regulation no. 2216/2004/EC for a standardized and secured system of registries pursuant to Directive 2003/87/EC and Decision 280/2004/EC.

The Executive Environment Agency plays a role of registry administrator as stated in Commission Regulation 2216/2004 and it is performing the current keeping and realization of the registry according to Art. 3(2) of the ORDINANCE on the rules and procedures concerning the functioning of the National registry for accounting of the issue, holding, acquisition, transfer cancellation and retirement of GHG emissions allowance.

In this respect the following activities have been performed:

- Installation of technical equipment;
- Set-up of the communication tracks;
- Purchase and installation of the GRETA software.

In order to demonstrate that the National Registry of Bulgaria implements the Data Exchange Standards an initialisation process with the ITL has been undertaken in order to demonstrate that it fulfils all required registry functions to the appropriate standard.

The Bulgarian registry passes the three phases as follows:

- Documentation review – In order to satisfy the LogicaCMG and the UNFCCC Bulgarian registry developed a documentation pack which contains the following documents: Registry Readiness Questionnaire, Backup Restore Plan, Disaster Recovery Plan, Security Plan, Application Logging Documentation, Time Validation Procedure; Change Management Procedure; Test Plan; Test Report; Operational Plan. The prepared documentation was submitted to the LogicaCMG on 3 December 2007.
- Connectivity testing – On 17 December the national registry passes successfully VPN test and on 10-11 January passed successfully SSL test.
- Functional testing – The Bulgarian registry passed successfully Annex H testing on 28 and 29 January 2008.

The initial Independent Assessment Report (IAR) of the national registry of Bulgaria was finalised in April 2008 and indicates that the Bulgarian registry is deemed fully compliant with the registry requirements defined in decisions 13/CMP.1 and 5/CMP.1.

The National registry started initialisation procedures with Community Independent Transaction Log on 3 December 2007 as submitted the documentation required according to the Annex XIV of COMMISSION REGULATION (EC) No 2216/2004. It includes information on the registry, Description of the primary and backup hardware and software used by the registry, Change Management Procedure, Security Plan,

Administrative procedures for creating accounts in the Bulgarian Emission Trading Registry.

The documents revised according to the recommendation of EC were submitted to CITL on 14 January 2008. On 24 January National Registry received confirmation of the submitted revised documents by CITL. Version 2.3 of Greta software and digital certificates submitted by CITL was installed.

Bulgaria has not performed the connectivity and functional testing against the Community Independent Transaction Log yet.

Demonstration of full and successful testing of the registry against the Community Independent Transaction Log (CITL) implemented under the EU emissions trading scheme, once the CITL is connected to the ITL is recommendation made by the ITL Operator to the national registry.

1.2.1. Data Sources for GHG Inventory

The Executive Environment Agency (EEA) coordinates all activities, related to collecting data on fuels and other sources of GHG emissions. EEA is the core body for collecting inventory data, aggregated on a national level by the following state authorities:

- National Statistical Institute (NSI);
- Road Control Department (RCD) within the Ministry of Internal Affairs;
- Statistics Department within Ministry of Agriculture and Food Supply (MAFS);
- Ministry of Economy and Energy (MEE);
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- National Service for Plant Protection, Quarantine and Agro chemistry;
- Energy Efficiency Agency (EEA).

The NSI plays a special role in data collection system for the inventory. Data for energy and material balances of the country, as well as major part of the calculations on the national inventory under the CORINAIR methodology are prepared in NSI. All data, related to solid waste and wastewater, is also collected there.

NSI uses up-to-date statistical methods and procedures for data summarizing and structuring, harmonized with the provisions and methods of EUROSTAT.

The GHG inventory used data, received directly from large GHG emissions sources in the energy sector and the industry and this data is summarized by EEA.

1.2.2. National Inventory Report and CRF Tables

MoEW is responsible to the UNFCCC for the annual GHG inventory submission. The Ministry organizes preparation of the inventory. ExEA prepares all activities, related to the calculations of GHG emissions, drawing up and structuring of the results and analyses in the National Inventory Report.

1.3. Brief Description of the Inventory Preparation Process

The GHG inventory represents a process, covering the following main activities:

- Collecting, processing and assessment of input data on used fuels, produced output, materials and other GHG emission sources;

- Selection and application of emission factors for estimating the emissions;
- Determination of the basic (key) GHG emission sources and assessment of the results uncertainty.

Each year during inventory, some changes occur that affect directly the activities above enlisted. Important inventory stage is the process of data transformation into a form, suitable for CRF Tables format. During this process, aggregation of the fuels by type is made (solid, liquid and gaseous), and further data is added, regarding parameters and indices, specifying the systems for transportation and distribution of oil and natural gas, the systems for fertilizer processing, etc. These activities are just a part of additional data, filled in the CRF Tables.

1.4. Brief General Description of Methodologies and Data Sources Used

The GHG inventory for the year 2006 was carried out in compliance with the 1996 Revised IPCC Guidelines, at closer abidance to the Good Practice Guidance recommendations.

The basic source for emission factors for current inventory was again the local practice, IPCC Revised Guidelines and the Good Practice Guidelines. Some data from the CORINAIR methodology is also used.

The specific Bulgarian circumstances for many activities were recognized, applying relevant parameters and emission factors. It concerned particularly the emission factors in the sectors Energy, Agriculture, some industrial processes and particularly the road transport. The transport data is obtained based on scientific and practical research, considering the specifics of the motor fleet in the country. Due to the significant changes of the motor fleet during the past 6-7 years, and as a result of the renovation trend, all emission factors have to be revised in the near future, in accordance with the adopted motor vehicles categories (cars, buses, trucks).

Table 1.1 shows the methods and the emission factors applied, according to the adopted designations in the IPCC methodology, as follows:

Methods applied

D – IPCC standard method;

T 1, 2, 3 – methods of the type Tier 1, 2, 3;

NO – such method/emission factor not available;

RA – reference method;

NE – no estimation available.

Emission factors applied

D – standard IPCC emission factor;

CR – by CORINAIR;

CS – specific for the country.

Table 1.1 CRF Summary table 3 with methods and emission factors applied

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	**T1, T2**	**CS, D**	**T1, T2**	**CS, D**	**T1, T2**	**CS, D**
A. Fuel Combustion	T1, T2	CS, D	T1, T2	CS, D	T1, T2	CS, D
1. Energy Industries	T2	CS	T2	CS	T2	D
2. Manufacturing Industries and Construction	T2	CS	T2	CS	T2	D
3. Transport	T1, T2	CS, D	T1, T2	CS, D	T1, T2	CS, D
4. Other Sectors	T2	CS	T2	CS	T2	D
5. Other	NA	NA	T1	D	T1	D
B. Fugitive Emissions from Fuels	NA	NA	T1	D	NA	NA
1. Solid Fuels	NA	NA	T1	D	NA	NA
2. Oil and Natural Gas	NA	NA	T1	D	NA	NA
2. Industrial Processes	**D,T1,T2**	**CS, D**	**D**	**CR, D**	**D**	**D**
A. Mineral Products	D,T1,T2	D	NA	NA	NA	NA
B. Chemical Industry	D, T1	CS, D	D	CR	D	D
C. Metal Production	D	CS	D	D	NA	NA
D. Other Production	NA	NA				
E. Production of Halocarbons and SF6						
F. Consumption of Halocarbons and SF6						
G. Other	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**D**	**CS**			**D**	**CS**
4. Agriculture			**D,T1,T2**	**CS, D**	**D**	**CS, D**
A. Enteric Fermentation			T1	D		
B. Manure Management			T1, T2	CS, D	D	D
C. Rice Cultivation			D	CS		
D. Agricultural Soils			NA	NA	D	D
E. Prescribed Burning of Savannas			NA	NA	NA	NA
F. Field Burning of Agricultural Residues			D	CS, D	D	CS, D
G. Other			NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**T1**	**CS**	**NA**	**NA**	**NA**	**NA**
A. Forest Land	T1	CS	NA	NA	NA	NA
B. Cropland	T1	CS	NA	NA	NA	NA
C. Grassland	T1	CS	NA	NA	NA	NA
D. Wetlands	NA	NA	NA	NA	NA	NA
E. Settlements	NA	NA	NA	NA	NA	NA
F. Other Land	NA	NA	NA	NA	NA	NA
G. Other	NA	NA	NA	NA	NA	NA
6. Waste						
A. Solid Waste Disposal on Land	NA	NA	T2	CS, D		
B. Waste-water Handling			D	CS, D	D	D
C. Waste Incineration	NA	NA	NA	NA	NA	NA
D. Other	NA	NA	NA	NA	NA	NA
7. Other (as specified in Summary 1.A)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Carbon Dioxide Emissions

The CO_2 emissions are derived by combustion of fuels in the energy sector, transport and households. Data from the energy balance of the country is used for their calculation, as the balance summarizes on the national level the production, the input and the output, the distribution and the end consumption of the energy sources.

Parameters, specified in the Revised IPCC Guidelines, are used for estimation of the carbon stocks in the products, which is not CO_2 emission source, because of the lack of concrete data for the fuels, utilized in Bulgaria.

Because of the fact, that the combustion of solid waste is not spread in the country (for power production or for the purpose of liquidation), the corresponding CO_2 emissions are not reported.

Carbon Dioxide Sequestration

For the time being, Bulgaria reports on CO_2 sequestration from forestry only (category 5.A from sector Land-Use Change and Forestry). Data for C sequestration from forestry is based on:

- Area of forestry used;
- Average annual forest growth by species (in m^3/ha/year);
- Annual felling (in m^3/year).

Estimation of the average annual forest biomass growth is made based on data from forestry inventory, which is made each five years according to a methodology, approved by the forestry authorities. For estimation of the biomass dry content, a common conversion factor of 0.6 for both forestry types, coniferous and deciduous, is used.

There is an absorbing of CO_2 in the areas of agricultural crops, meadows and all roadside and village plantations. In the present inventory, the amassed quantities of carbon in some of these areas are reported in the new LULUCF common table format.

Methane

CH_4 emissions from fuel combustions are estimated by data from the energy balance and the emission factors, as methods of the type Tier 2 are applied.

CH_4 emissions from road transport are estimated with emission factors, specified for the various motor vehicle categories. The main restrictions in this case are the quantities of used fuels, indicated in the general energy balance of the country.

Fugitive CH_4 emissions from coal mining and the systems for extraction and distribution of oil and natural gas are estimated, as a rule, by standard emission factors, specified in IPCC Guidance. Complete revision of the emission factors was carried out with the previous inventory, especially for the systems for distribution of oil and natural gas. The emission factors were replaced by data, indicated in Good Practice Guidance.

Methane emissions from agriculture are estimated by method of the type Tier 1, excluding the manure handling emissions of cattle's and swine, where method of the type Tier 2 is used.

Methane emissions from solid waste disposal sites are estimated by the Tier 2 method, specified in IPCC Guidance. Using of methods with higher accuracy became possible

after ensuring long enough historical series of values of the time series for disposed household solid waste.

Nitrous Oxide

N_2O emissions from fuel combustions are estimated by data from the general energy balance of the country and emission factors, specific for the country. The emissions from road transport are estimated based on the fuels used from the various motor vehicle categories, and specific emission factors, defined for each category. Those emission factors have been defined by experimental analytic method for the period until 1995, and have not been changed since then.

N_2O emissions from agriculture soils are estimated in full accordance with the IPCC methodology. These emissions include all necessary sources, such as synthetic and natural fertilizers, crop residues, animal waste from pastures and indirect emissions from release of ammonia and NOx in the atmosphere, as well as due to drainage (leaching) of underground water.

Consumed proteins are calculated based on the statistical data for the foodstuffs, consumed by humans. N_2O emissions are estimated on the proteins from the human waste, structured in sector Waste.

F - gases

There is no production of F- gases from the PFC, HFC and SF_6 groups in Bulgaria. Data on F - gases consumption is limited and allows just general assessments of the potential emissions of HFCs, PFCs and SF_6.

During the last years, large-scale inquiries were initiated for data collection regarding the available SF_6 quantities in the electrical equipment of the electric power system of the country. It resulted in reliable data for the fugitive SF_6 emissions during equipment operation for the period 1995-2006.

Original Data Sources for the Inventory

The original data sources on GHG are as follows:

- data on used fuels - general energy balance of Bulgaria, prepared by NSI;

- data on consumed households biomass - MAFS statistics and NSI energy balance;

- vehicles number, types and models – MIA – Department of the road control;

- industrial output – companies' reports summarized in the material balances of NSI; independent companies' reports etc.

- SF_6 fugitive emissions - reports from the units of the Ministry of Economy and Energy (MEE); reports of factory power-plants to companies;

- number of farming animals and plant crops - "Agrostatistics" Department within MAFS;

- quantity of used synthetic fertilizers - National Service for Plant Protection, Quarantine and Agro chemistry within MAF;

- land-use change and forestry - State Forestry Agency;

- disposal of solid waste and quantity of waste water: "Environment" Department of NSI and "Waste" Department within MoEW.

Certain portion of the above-mentioned data is available on the web pages of NSI, MEE and MAFS.

1.5. Brief Description of Key Categories

The identification of key source categories is described in the IPCC Good Practice Guidance, 2000. A key source category is one that is prioritised within the National System because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both.

The identification includes all reported greenhouse gases CO_2, CH_4, N_2O, HFC, PFC and SF_6, and all IPCC source categories, except LULUCF. Emissions and removals from LULUCF have not been considered in this key source analysis, but the results of a key category analysis including emissions and removals from LULUCF are included in Annex 1 (Tables 1A3 – 1A4).

The presented key source analysis was performed with data for greenhouse gas emissions of the submission 2008 to the UNFCCC and comprises a level assessment for the years between 1988 and 2006 and a trend assessment for the trend of the year 2006 with respect to base year emissions.

The identified key source categories are presented in Table 1.2

Table 1.2 Key source categories 2006

IPCC Source Categories		Gas	Emissions 2006 Gg CO_2 - eq.	Share in National Total Emissions 2006
1A1A	Public Electricity and Heat Production - Solid fuels	CO2	25369.35	35.56%
6A	Solid Waste Disposal on Land	CH4	6847.03	9.60%
1A3b	Road Transportation - Diesel Oil	CO2	4504.10	6.31%
1A2	Manufacturing Industries and Construction - Solid Fuels	CO2	4010.29	5.62%
1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO2	3267.68	4.58%
1A2	Manufacturing Industries and Construction - Liquid Fuels	CO2	2985.92	4.19%
1A3b	Road Transportation - Gasoline	CO2	1919.71	2.69%
1A1A	Public Electricity and Heat Production - Gaseous fuels	CO2	1906.42	2.67%
2C1	Iron and Steel	CO2	1547.98	2.17%
2A1	Cement Production	CO2	1488.39	2.09%
1A3b	Road Transportation - LPG	CO2	1194.66	1.67%
1B1	Fugitive Emissions from Fuels - Solid Fuels	CH4	1187.03	1.66%
1A4b	Residential - Solid Fuels	CO2	1163.90	1.63%
4D1	Direct soil emissions	N2O	1039.38	1.46%
2A2	Lime Production	CO2	1038.41	1.46%
4A1	Cattle	CH4	918.24	1.29%
2B2	Nitric Acid Production	N2O	899.72	1.26%
4D3	Indirect Emissions	N2O	818.78	1.15%
1A3e	Other Transportation - Liquid Fuels	CO2	787.88	1.10%

1A1c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO2	706.64	0.99%
1A1c	Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO2	697.53	0.98%
2F	ODS substitutes	HFCs	610.68	0.86%
1B2	Fugitive Emissions from Fuels - Oil and Natiral Gas	CH4	606.08	0.85%
6B	Waste Water Handling	CH4	577.88	0.81%
4D2	Pasture, Range and Paddock Manure	N2O	520.47	0.73%
2B1	Ammonia Production	CO2	467.45	0.66%
4B	Manure Management	N2O	366.25	0.51%
2A3	Limestone and Dolomite Use	CO2	329.47	0.46%
4A3	Sheep	CH4	271.96	0.38%
1A4a	Commercial/Institutional - Liquid Fuels	CO2	204.94	0.29%
4B8	Swine	CH4	204.23	0.29%
1A1A	Public Electricity and Heat Production - Liquid fuels	CO2	149.49	0.21%
1A3a	Civil Aviation - Liquid Fuels	CO2	122.10	0.17%
1A4c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO2	117.17	0.16%
1A4b	Residential - Liquid Fuels	CO2	74.34	0.10%
1A3d	Navigation - Liquid Fuels	CO2	0	0.00%

There is a difference in the identified key categories compared to the NIR 2007 because of the more disaggregating level of the key category identification, which is more closely with the IPCC Good Practice Guidance, 2000.

Results of applying the method Tier 1 in its two varieties (quantitative assessment of the share in the overall emissions, and trend assessment for each source compared to the overall emission trend) are given on the Annex 1 of this report.

1.6. Information on the QA/QC Plan Including Verification and Treatment of Confidentiality Issues

Drawing up the GHG inventory is an aggregate of activities, subject of quality assessment and quality control.

The systems for quality assessment and quality control (QA/QC) are part of working procedures in the Bulgarian companies and organizations, and are subject of international quality control certification.

Issues on quality management of the following two stages of preparing the inventory will be discussed herein: preparation of initial data and calculation of the GHG emissions; and compiling of original CRF Tables and the National Inventory Report.

Quality Management of the Sources of Initial Data

Each organization – data source, solves the quality management issues in accordance with its internal rules and provisions. With some of the sources as NSI, MOI, etc., those rules follow strictly the international practices. For example, quality assessment/quality control procedures with NSI have been harmonized with the relevant instructions and provisions of EUROSTAT.

Some of the large enterprises – GHG emission sources, have arranged and effective quality management systems. Most of them have introduced quality management systems based on ISO 9001:2000 standard.

Quality Management of the National Inventory Report and the CRF Tables

According to the IPCC GPG, 2000 the QA/QC system that should be implemented for GHG inventories consists of several elements:

(1) Inventory agency responsible for coordinated QA/QC activities;

(2) QA/QC Plan;

(3) General QC procedures (Tier 1);

(4) Source category-specific QC procedures (Tier 2);

(5) QA review;

(6) Reporting, documentation and archiving.

Bulgaria's reporting obligations to the UNFCCC and EC are being administered by the Ministry of Environment and Water (MoEW). The Executive Environment Agency (ExEA) has been identified as the single national entity with the overall responsibility for preparation of Bulgaria's National GHG Inventory and relevant National Inventory Report (NIR).

The QA/QC plan is a fundamental element of a QA/QC system. The plan outline QA/QC activities that will be implemented and include a scheduled time frame that follows inventory preparation from its initial development through to final reporting in any year. It contains an outline of the processes and schedule to review all source categories.

The QA/QC plan is an internal document to organise, plan and implement QA/QC activities. Once developed, it can be referenced and used in subsequent inventory preparation, or modified as appropriate.

The preparation of the inventory includes the three main stages: planning, preparation and management.

I. Inventory planning

Every reporting year begin with the following discussions and activities:

- to determine of the sector experts;
- to notice the objectives, activities and improvements;
- to prepare a timetable with the relevant deadlines according submission under Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol and submission under United Nations Framework Convention on Climate Change (UNFCCC).

When planning the particular inventory the following documents are taken into account with regard to potential inventory improvements:

- Inventory Improvement Plan for the relevant reported year
- Recommendations of UNFCCC (reviews)

- Other recommendations
- Research
- Plan operators and industrial associations recommendations and/or remarks

Inventory improvements are implemented before the inventory is compiled.

II. QA/QC Activities

The QA/QC Managers perform the following general activities:

- Prepare the QA/QC plan for the current inventory/year and manage its implementation;
- Follow-up and understanding of the QA/QC Procedures and the content of the IPCC Good Practice Guidance (Chapter 8, Quality Assurance and Quality Control);
- Check whether spreadsheets for each source category follow these procedures; both general procedures and specific checks are indicated below;
- Document the findings and results of the checks, by completing the Tier 1 checklist and Attendant File (AF), including the summaries of results and problems to be corrected. Thus, providing the potential for improvements in the inventory and lightening the work of developers of next inventory;
- Take any corrective action as needed, documenting (in the appropriate place on the Tier 1 checklist and AF) the actions taken and the results.
- Placing of all relevant documentation (including the final completed checklist and AF) in the project file (with copies given to the responsible agencies). Also preparing the draft AF for the next inventory.

III. Quality Control Procedures

The quality control procedures have to be followed both to control and to check the quality of the inventory estimates and the Inventory Report, and to manage and handle the data associated with the inventory.

Quality Control, as defined by the Intergovernmental Panel on Climate Change (IPCC) in its IPCC Good Practice Guidance is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. A basic QC system should provide routine and consistent checks to ensure data integrity, correctness, and completeness, and to identify and address errors and omissions. It also provides procedures for documenting and archiving inventory material and recording all QC activities.

Following the definitions developed for the IPCC Good Practice Guidance, general procedures (Tier 1) that all source categories should follow when gathering, maintaining, handling, documenting, checking and archiving the data, supporting documents, and files (both text documents and spreadsheets) are associated with the inventory.

While procedures for maintaining data quality should be followed at all times, not all checks need to be performed always when the inventory is modified. Some activities should be conducted every time (e.g., reviewing electronic data quality checks or inspecting files for completeness) or at least routinely (e.g., checking that all primary data points in the spreadsheet have citations to references). Some checks need to be

performed thoroughly once (e.g., checking the entire content of the archives for completeness and consistency) and then only occasionally thereafter. Other procedures or checks are triggered by changes that occur (e.g., changes in assumptions or in the calculation methodology).

1. Data Gathering, Input, and Handling

A number of common procedures govern the collection, maintenance, and use of electronic and transcribed data for all activity data, emission factors, and other primary data elements. Appropriate procedures can minimize the extent to which errors in data collection occur; various checks on the data and files can further reduce the errors that occur.

Procedures for the Inventory Team to follow include:

- Electronic data should be used to minimize transcription errors;
- Spreadsheet features should be used to minimize user error or entry error;
- If identical data are used by different source categories;
- The same electronic data file should be used by these source categories;
- It is useful to build in computerized and automated quality checks to highlight possible problems;
- Data flagged as confidential information should be password protected in the spreadsheets.

The QA/QC staff (and inventory staff) performs various hand checks to minimize data input errors. Checks include the following:

- Check for transcription errors among a representative sample of input data by cross-checking data against original source, among a sample of parameters used in calculations, activity data, or emission factors;
- Inspect possible problems highlighted by automated checks if possible. Automated systems should also be reviewed periodically to ensure that they are functioning properly.

The QA/QC Managers complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks are reported on the Tier 1 checklist.

2. Data Documentation

Documentation of the inventory is sufficiently detailed and clear as to allow an independent but knowledgeable analyst to obtain and review the references used and reproduce the emission estimates. Complete and accessible documentation of methods, spreadsheets, data and data sources is important.

2.1 Maintaining Files for whole inventory

The Inventory Team Leader (ITL) maintains a complete and separate file for whole inventory. The intent is that this file includes all the materials and the analyst needs to develop the inventory for the relevant year. The most important is that the files should

be maintained in a transparent manner. The ITL have considerable discretion over the form and content of the file (files).

A file should be maintained for the current inventory and should include all relevant information. The file should contain a list of the names and locations of all "working" spreadsheets, with explanations of links among them, and any recent electronic back-up copies of working drafts of the spreadsheets. It also should contain results of check/review with all necessary contact information, copies of reference materials or data. Copies of hand calculations or notes made by the inventory staff, appropriately documented, should be placed in the file. In addition, copies of the checklist completed for QA/QC purposes, together with the attendant file, should be placed in the file.

The QA/QC Managers check the files for completeness as part of Tier 1 quality control activities. Completed checks should be reported on the QA/QC checklist.

2.2 Documenting the Inventory Spreadsheets and the Inventory Report

The inventory staff should ensure that the documentation associated with the inventory is sufficient for an independent analyst to determine the reference source for each piece of data used to calculate emissions, and to locate the data in the inventory archives. The documentation should also provide complete information on any changes that are made to data sources or methodological changes that occur in a given inventory. Both the inventory spreadsheets and the Inventory Report itself are subject to scrutiny to determine that the references are complete, accurate, and consistent in format. Both the inventory staff and especially QA/QC Managers are familiar with the following procedures, which are designed to maintain high quality.

In the spreadsheets, every primary data element (activity data, emission factor, etc.) must have a reference for the source of the data. No non-calculated values should appear in the spreadsheets that are not referenced, with the exception of standard unit conversion factors or similar information.

Everything - supporting documentation, comments, and especially all printouts made from spreadsheets - should be dated.

The inventory team and QA/QC Managers perform various checks to verify the adequacy of the documentation of the spreadsheet.

The QA/QC Managers should complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks should be reported on the Tier 1 checklist.

2.3 General documentation of references

To the extent feasible, effort will be made to ensure the documentation follows a uniform format across the inventory spreadsheets.

Individuals, agency, institution, or company providing information should be identified by full name, association, phone and fax numbers, and the date information was provided and to whom. Complete bibliographical information is provided in references.

3. Calculating Emissions and Checking Calculations

The Inventory leader adopts appropriate procedures for designing and modifying spreadsheets, in order to reduce calculation errors occurring in the emission estimates.

A number of checks will ensure that appropriate procedures have been followed, as well as catch remaining errors. Checks include the following.

- Parameters, emission units and conversion factors for calculations is clearly labelled and referenced.
- Emission units, parameters, and conversion factors should not be hardwired into formulas; any value used more than once should be included in the spreadsheet (preferably at the head of the page where it first appears and highlighted) and every calculation using that value should reference that cell.
- Maintain the integrity of the database files and spreadsheets:
    - ✓ Confirm that the appropriate data processing steps are correctly represented in the spreadsheets (that the equations are correct).
    - ✓ Confirm that data relationships are correctly represented in the spreadsheets
    - ✓ Clearly differentiate between spreadsheet input data and calculated data.
- Check calculations within a source category:
    - ✓ Reproduce a representative sample of emission calculations to ensure mathematical correctness.
    - ✓ Build in automated checks, such as computational checks for calculations, or range checks for input data.
- Check that emissions data are correctly (1) aggregated from lower reporting levels to higher reporting levels when preparing summaries and (2) transcribed between different intermediate products.
- Check for temporal consistency in time series input data for each source category and check the method used to fill in gaps in reported data, if possible.
- Check for consistency in the algorithm/method used for calculations through the time series, if possible.
- Check that changes in methods or data are consistent with IPCC guidance on both inventory methods and good practices.

The QA/QC Managers complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks should be reported on the Tier 1 checklist.

4. Coordination on Cross Cutting Activities

It is critical that the QA/QC Managers follow procedures that are designed to reduce errors not only in the inventory estimates for individual source categories, but in the aggregated estimates that are reported, and in the Inventory Report and other documents that report the results of the inventory.

Some checks are performed for the overall inventory, or require checking data across source categories:

- Checking emission calculations across source categories;

- Check that internal documentation is comparable across source categories, (check that spreadsheets and references are consistently documented and procedures are consistently applied).
- Completeness:
    - ✓ Confirm that estimates are reported for all source categories.
    - ✓ Check that known data gaps that result in incomplete source category emission estimates are documented. Gaps resulting from the use of preliminary data, missing data, or proxy data should be documented in cell comments in the spreadsheet.
- Current inventory estimates should be compared to previous estimates. If there are significant changes or departure from expected trends, re-check estimates and explain any differences.

The QA/QC Managers complete these checks as relevant and concurrently identify other checks that may be relevant to the source category. All completed checks should be reported on the Tier 1 checklist.

5. Quality Assurance Procedures

Quality Assurance, as defined in the IPCC Good Practice Guidance, comprises a "planned system of review procedures conducted by personnel not directly involved in the inventory compilation and development process." The quality assurance process includes both expert review and a general public review.

The expert review is conducted in two stages: a review of the initial set of draft emission estimates and, subsequently, a review of the estimates and text of the Inventory Report. In addition, experts are consulted and involved throughout the development of the inventory estimates, providing further review and opportunities for evaluation and assessment of the inventory methodologies and data. The ultimate goal of these expert reviews is to provide an objective review of the inventory in order to ensure that the final inventory estimates and Inventory Report reflect sound technical information and analysis.

The expert and public reviews each present opportunity to uncover technical issues related to the application of methodologies, selection of activity data, or the development and choice of emission factors. The expert and public reviews of the draft document offer a broader range of researchers and practitioners in government, industry and institutes, the opportunity to contribute to the final document. The comments received during these processes are reviewed and, as appropriate, incorporated into the Inventory Report or reflected in the inventory estimates.

6. Internal Quality Audits for Tier 1

In perspective, an audit system will be developed to provide additional QA measures. One approach to auditing is to conduct periodic audits, using internal or external personnel, but excluding the analyst involved in a particular source category. Analysts from other source categories could be used to conduct these audits.

Several types of activities could be conducted during an audit, including duplicating/repeating all the QC procedures, checking the qualifications of staff involved

in inventory preparation, checking procedures for project file maintenance, reviewing organizational functions and knowledge of procedures, etc.

IV. Inventory management (data archiving)

For the inventory management a reliable, user-friendly and effective data management to fulfill the data collecting and reporting requirements is needed.

The data will be stored in a central network server, which is backed up **daily** for the needs of data security. Furthermore, as part of the QMS, backups of the entire inventory information are made **twice** a year on write-protected DVDs. The inventory management, as part of the QMS, includes a control system for all documents and data, for records and their archives as well as documentation on QA/QC activities.

This ensures the necessary documentation and archiving for future reconstruction of the inventory and for the timely response to requests during the review process.

Within the inventory system, a system for transparent documentation of inventory data and information that allows reproduction of inventory has to be implemented. This documentation is at this stage the National Inventory Report (NIR). To allow clear references in documentation of inventory, an archiving system for literature, mails, documents, calculations, two excel sheets are needed: *Archiv_Inventory.xls* and *Archiv_mails.xls*

The archived documents are stored on server and in inventory archive (paper).

For each sector the documentation includes:

- ✓ Description
- ✓ Information on completeness
- ✓ Methodology
- ✓ References for activity data, emission factor and emissions
- ✓ Uncertainty
- ✓ Recalculations
- ✓ Planned improvements

1.7. General Uncertainty Evaluation

As a whole, the uncertainty assessment of the GHG inventories follows the methodology of Good Practice Guidance, Chapter 6.

It is known that the overall uncertainty is closely related to the GHG emission sources data uncertainty (fuels, activities, processes, etc.) and to the emission factor uncertainty.

The uncertainty of the GHG **emission sources** can be defined during data collection and processing, and it is a part of procedures, applied by the statistical agencies and organizations. Different criteria for uncertainty assessment are used, for example as statistical subtraction, on basis on differences between the production, import, export and consumption of fuels, through expert assessments, etc.

The uncertainty of the **emission factors** depends on the origin of the factors applied. In case the emission factors result from direct periodical measurements, the uncertainty is determined by the relevant methodology, related to the measuring methods and apparatuses.

The overall uncertainty of the GHG inventory is determined by combining the emission sources uncertainty and the emission factors uncertainty.

Two rules are applied in this process:

- Rule A – combination of the uncertainties by summing;
- Rule B – combination of the uncertainties by multiplying.

Since the GHG inventories are sums of products of emission sources, multiplied by emission factors, the two rules above can be used for determining the overall uncertainty of the inventory.

Rules A and B represent the foundation of the Tier 1 method, recommended in the Good Practice Guidance.

The overall uncertainty assessments for the 2006 GHG inventory, as well as the trend uncertainty compared to the base year (1988), are made by the Tier 1 method.

The necessary uncertainties for all the emission sources (key and non-key) and emission factors are presented in **Table 1.3**.

Following data are used for assessment of uncertainties:

- the standard statistical subtraction, which is bound to the general energy balance of the country;

- exemplary assessments, proposed by the Good Practice Guidance;

- expert assessments of local and foreign experts on agriculture activities, waste management, etc.;

- reference data and information for inventories in the Netherlands, Slovakia, Canada, Austria, etc.

Table 1.3 Uncertainty calculation and reporting (level assessment), %

IPCC Source category	Gas	Activity data uncertainty	Emission factor uncertainty
Solvent and Other Product Use	CO_2	10	30
Solvent and Other Product Use	N_2O	100	0
Energy Industries	CH_4	5	50
Energy Industries	N_2O	5	200
Public Electricity and Heat Production - Gaseous fuels	CO_2	5	5
Public Electricity and Heat Production - Liquid fuels	CO_2	5	5
Public Electricity and Heat Production - Solid fuels	CO_2	5	7
Petroleum Refining - Gaseous fuels	CO_2	5	5
Petroleum Refining - Liquid fuels	CO_2	5	5
Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	5	5
Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	5	5
Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CO_2	5	7
Manufacturing Industries and Construction - Gaseous Fuels	CO_2	5	5
Manufacturing Industries and Construction - Liquid Fuels	CO_2	5	5
Manufacturing Industries and Construction - Solid Fuels	CO_2	5	7
Manufacturing Industries and Construction	CH_4	5	50
Manufacturing Industries and Construction	N_2O	5	200
Civil Aviation - Liquid Fuels	CO_2	5	5
Civil Aviation - Liquid Fuels	CH_4	3	40
Civil Aviation - Liquid Fuels	N_2O	3	40
Road Transportation - Diesel Oil	CO_2	3	5
Road Transportation - Gasoline	CO_2	3	5
Road Transportation - Liquid Fuels	CH_4	3	40
Road Transportation - Liquid Fuels	N_2O	3	40
Road Transportation - LPG	CO_2	3	5
Railways - liquid fuels	CO_2	5	5
Railways - liquid fuels	CH_4	5	100
Railways - liquid fuels	N_2O	5	150
Navigation - Liquid Fuels	CO_2	50	5
Navigation - Liquid Fuels	CH_4	50	50
Navigation - Liquid Fuels	N_2O	50	100
Other Transportation - Liquid Fuels	CO_2	5	5
Other Transportation - Liquid Fuels	CH_4	5	100
Other Transportation - Liquid Fuels	N_2O	5	150
Other sectors	CH_4	5	50
Other sectors	N_2O	5	200
Commercial/Institutional - Gaseous Fuels	CO_2	5	5
Commercial/Institutional - Liquid Fuels	CO_2	5	5
Commercial/Institutional - Solid Fuels	CO_2	5	7
Residential - Liquid Fuels	CO_2	5	5
Residential - Solid Fuels	CO_2	5	7

Residential - Gaseous Fuels	CO_2	5	7
Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	5	5
Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	5	5
Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	5	7
Stationary - Biomass	CH_4	5	20
Stationary - Biomass	N_2O	5	20
Stationary	CO_2	5	5
Fugitive Emissions from Fuels - Solid Fuels	CH_4	10	200
Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	5	50
Cement Production	CO_2	3	30
Lime Production	CO_2	5	15
Limestone and Dolomite Use	CO_2	5	15
Soda Ash Production and Use	CO_2	5	20
Other	CO_2	5	20
Ammonia Production	CO_2	5	20
Nitric Acid Production	N_2O	10	200
Calcium Carbide	CO_2	5	20
Other	CH_4	5	50
Metal Production	CH_4	5	20
Iron and Steel Production	CO_2	3	10
Ferroalloys Production	CO_2	5	25
ODS substitutes	HFCs	10	50
Electrical Equipment	SF_6	10	50
Other	CH_4	10	50
Buffalo	CH_4	2	50
Sheep	CH_4	2	50
Goats	CH_4	2	50
Horses	CH_4	2	50
Mules and Asses	CH_4	2	50
Swine	CH_4	2	50
Poultry	CH_4	2	50
Cattle	CH_4	2	50
N2O emission from Manure Management	N_2O	2	300
Buffalo	CH_4	2	50
Sheep	CH_4	2	50
Coats	CH_4	2	50
Horses	CH_4	2	50
Mules and Asses	CH_4	2	50
Swine	CH_4	2	50
Poultry	CH_4	2	50
Cattle	CH_4	2	50
Rice Cultivation	CH_4	25	80
Direct soil emissions	N_2O	3	250
Pasture, Range and Paddock Manure	N_2O	3	250
Indirect Emissions	N_2O	3	500
Field Burning	CH_4	25	50

Field Burning	N_2O	25	200
Solid Waste Disposal on Land	CH_4	20	100
Waste Water Handling	CH_4	30	80
Waste Water Handling	N_2O	30	100

The calculations for the uncertainty of every source of emission (key or non-key) are given in Table 1.4. Here combined uncertainty means the mean quadratic value of the uncertainty for every source and for every emission factor, given in Table 1.3.

Table 1.4 Tier 1 Uncertainty Calculation and Reporting (level assessment), Gg CO_2-eq.

IPCC source category	Gas	1988	2006	Comb.uncertainty, %	Combined uncertainty as % of total national emissions in year 2006	Uncertainty introduced into the trend in total national emissions
Solvent and Other Product Use	CO_2	23.05	10.17	31.6	0.00	0.00
Solvent and Other Product Use	N_2O	52.93	45.23	100.0	0.06	0.05
Energy Industries	CH_4	17.73	9.54	50.2	0.01	0.00
Energy Industries	N_2O	302.11	250.54	200.1	0.70	0.13
Public Electricity and Heat Production - Gaseous fuels	CO_2	3378.80	1906.42	7.1	0.19	0.10
Public Electricity and Heat Production - Liquid fuels	CO_2	8520.31	149.49	7.1	0.01	0.17
Public Electricity and Heat Production - Solid fuels	CO_2	31317.79	25369.35	8.6	3.06	1.43
Petroleum Refining - Gaseous fuels	CO_2	0.00	50.63	7.1	0.01	0.00
Petroleum Refining - Liquid fuels	CO_2	0.00	0.00	7.1	0.00	0.00
Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	0.00	697.53	7.1	0.07	0.05
Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	0.00	706.64	7.1	0.07	0.05
Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CO_2	0.00	160.62	8.6	0.02	0.01
Manufacturing Industries and Construction - Gaseous Fuels	CO_2	7661.43	3267.68	7.1	0.32	0.18
Manufacturing Industries and Construction - Liquid Fuels	CO_2	7740.27	2985.92	7.1	0.30	0.17
Manufacturing Industries and Construction - Solid Fuels	CO_2	9352.86	4010.29	8.6	0.48	0.22
Manufacturing Industries and Construction	CH_4	11.91	4.79	50.2	0.00	0.00
Manufacturing Industries and Construction	N_2O	44.90	18.94	200.1	0.05	0.01
Civil Aviation - Liquid Fuels	CO_2	611.59	122.10	7.1	0.01	0.01
Civil Aviation - Liquid Fuels	CH_4	1.31	0.09	40.1	0.00	0.00
Civil Aviation - Liquid Fuels	N_2O	0.22	0.00	40.1	0.00	0.00
Road Transportation - Diesel Oil	CO_2	3183.96	4504.10	5.8	0.37	0.18
Road Transportation - Gasoline	CO_2	4562.80	1919.71	5.8	0.16	0.06
Road Transportation - Liquid Fuels	CH_4	53.52	30.05	40.1	0.02	0.00
Road Transportation - Liquid Fuels	N_2O	48.28	58.32	40.1	0.03	0.01
Road Transportation - LPG	CO_2	0.73	1194.66	5.8	0.10	0.06
Railways - liquid fuels	CO_2	368.04	93.12	7.1	0.01	0.01
Railways - liquid fuels	CH_4	0.57	0.15	100.1	0.00	0.00
Railways - liquid fuels	N_2O	2.86	0.72	150.1	0.00	0.00
Navigation - Liquid Fuels	CO_2	1088.46	0.00	50.2	0.00	0.02
Navigation - Liquid Fuels	CH_4	1.75	0.00	70.7	0.00	0.00
Navigation - Liquid Fuels	N_2O	8.47	0.00	111.8	0.00	0.00

Other Transportation - Liquid Fuels	CO_2	3940.74	787.88	7.1	0.08	0.07
Other Transportation - Liquid Fuels	CH_4	5.32	2.14	100.1	0.00	0.00
Other Transportation - Liquid Fuels	N_2O	29.91	6.13	150.1	0.01	0.01
Other sectors	CH_4	34.81	124.12	50.2	0.09	0.04
Other sectors	N_2O	49.41	44.56	200.1	0.12	0.03
Commercial/Institutional - Gaseous Fuels	CO_2	197.23	147.20	7.1	0.01	0.01
Commercial/Institutional - Liquid Fuels	CO_2	524.72	204.94	7.1	0.02	0.01
Commercial/Institutional - Solid Fuels	CO_2	345.59	30.61	8.6	0.00	0.01
Residential - Liquid Fuels	CO_2	2158.34	74.34	7.1	0.01	0.04
Residential - Solid Fuels	CO_2	4495.56	1163.90	8.6	0.14	0.09
Residential - Gaseous Fuels	CO_2	0.00	57.25	8.6	0.01	0.00
Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	11.44	74.88	7.1	0.01	0.00
Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	1095.09	117.17	7.1	0.01	0.02
Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	112.27	26.96	8.6	0.00	0.00
Stationary - Biomass	CH_4	35.13	28.79	20.6	0.01	0.00
Stationary - Biomass	N_2O	10.62	8.70	20.6	0.00	0.00
Stationary	CO_2	0.00	0.00	7.1	0.00	0.00
Fugitive Emissions from Fuels - Solid Fuels	CH_4	1991.58	1187.03	200.2	3.33	0.21
Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	1278.97	606.08	50.2	0.43	0.04
Cement Production	CO_2	2006.25	1488.39	30.1	0.63	0.10
Lime Production	CO_2	1117.84	1038.41	15.8	0.23	0.07
Limestone and Dolomite Use	CO_2	457.87	329.47	15.8	0.07	0.02
Soda Ash Production and Use	CO_2	233.19	163.08	20.6	0.05	0.01
Other	CO_2	26.61	131.81	20.6	0.04	0.02
Ammonia Production	CO_2	1662.13	467.45	20.6	0.14	0.07
Nitric Acid Production	N_2O	2421.72	899.72	200.2	2.53	0.62
Calcium Carbide	CO_2	89.32	23.05	20.6	0.01	0.00
Other	CH_4	0.84	2.74	50.2	0.00	0.00
Metal Production	CH_4	73.20	41.84	20.6	0.01	0.00
Iron and Steel Production	CO_2	2360.38	1547.98	10.4	0.23	0.05
Ferroalloys Production	CO_2	112.80	44.03	25.5	0.02	0.00
ODS substitutes	HFCs	2.95	610.68	51.0	0.44	0.24
Electrical Equipment	SF_6	1.26	5.30	51.0	0.00	0.00
Other	CH_4	7.62	0.00	51.0	0.00	0.00
Buffalo	CH_4	27.60	9.50	50.0	0.01	0.00
Sheep	CH_4	1469.57	271.96	50.0	0.19	0.20
Goats	CH_4	45.36	60.77	50.0	0.04	0.01
Horses	CH_4	46.27	79.88	50.0	0.06	0.02
Mules and Asses	CH_4	74.61	38.66	50.0	0.03	0.00
Swine	CH_4	128.41	30.80	50.0	0.02	0.01
Poultry	CH_4	8.74	4.17	50.0	0.00	0.00
Cattle	CH_4	2248.00	918.24	50.0	0.64	0.11
N2O emission from Manure Management	N_2O	1056.05	366.25	300.0	1.54	0.46
Buffalo	CH_4	4.52	1.55	50.0	0.00	0.00
Sheep	CH_4	51.43	9.52	50.0	0.01	0.01
Coats	CH_4	1.63	2.19	50.0	0.00	0.00
Horses	CH_4	5.35	9.23	50.0	0.01	0.00
Mules and Asses	CH_4	8.51	4.41	50.0	0.00	0.00

Swine	CH_4	851.44	204.23	50.0	0.14	0.10
Poultry	CH_4	102.25	48.74	50.0	0.03	0.00
Cattle	CH_4	498.52	204.87	50.0	0.14	0.02
Rice Cultivation	CH_4	119.25	42.98	83.8	0.05	0.02
Direct soil emissions	N_2O	3273.15	1039.38	250.0	3.64	1.36
Pasture, Range and Paddock Manure	N_2O	1652.29	520.47	250.0	1.82	0.70
Indirect Emissions	N_2O	2824.66	818.78	500.0	5.74	2.65
Field Burning	CH_4	46.35	26.13	55.9	0.02	0.01
Field Burning	N_2O	15.10	7.36	201.6	0.02	0.00
Solid Waste Disposal on Land	CH_4	10587.86	6847.03	102.0	9.79	1.70
Waste Water Handling	CH_4	1844.93	577.88	85.4	0.69	0.31
Waste Water Handling	N_2O	310.49	144.89	104.4	0.21	0.05
Overall uncertainty in the year					**13.33**	**3.92**

Results for every source are given in **Table 1.4.** as follows:

– combined uncertainty as a part of overall emissions for 2006;

It means that for every source has been calculated MCUi =(EMi/EMtotal)x CUi, where MCUi – measured combined uncertainty, EMi- source emissions for 2006, EMtotal – total country emissions for 2006, CNi – combined uncertainty of the i-th source.

– uncertainty of the overall emissions trend for 2006;

It means that for every source has been calculated HTi – overall emissions trend uncertainty brought in by the i-th source. This uncertainty calculates in column M of Table 6.1 of p.6.3.2 of the Good Practice Guidance (GPG)

The calculated uncertainties, in %, of the overall national GHG emissions for the year 2006 (row 7, column H in Table 6.1 of the GPG), and the overall emission trend related to the base inventory year until 2006 (row 7, column M in Table 6.1.) are given in **Table 1.5**. The relevant data for the previous inventories for 2004 and 2005 are given for comparison (NIR 2006 and NIR 2007).

Table 1.5 Uncertainty in total GHG emissions, %

Uncertainty	Uncertainty NIR 2006	Uncertainty NIR 2007	Uncertainty NIR 2008
Uncertainty in total GHG emissions	12.46	12.70	13.33
Overall uncertainty into the trend in total GHG emissions	3.208	3.47	3.92

1.8. General Assessment of Inventory Completeness

GHG inventory for 2006 covered all sectors, included in IPCC Good Practice Guidance, 1996, excluding:

- F-gases emissions from utilization of aerosols, fire extinguishers, solvents, semiconductor manufacture, etc.;

The above-mentioned emissions exist; however, there is no methodology for their determination and efficient input data collection developed.

Additional information about the inventory completeness is given in Annex 5**.**

CHAPTER 2 OVERALL GHG EMISSIN TRENDS

2.1. Aggregated GHG Emission Trends

GHG emission inventory for 2006 showed that the overall GHG emissions in CO_2–eq. amounted to 71 343.37 Gg, without reporting of sequestration from sector Land-Use Change and Forestry (LUCF). The net emissions (with reporting of sequestration from LUCF) were 64 347.37 Gg.

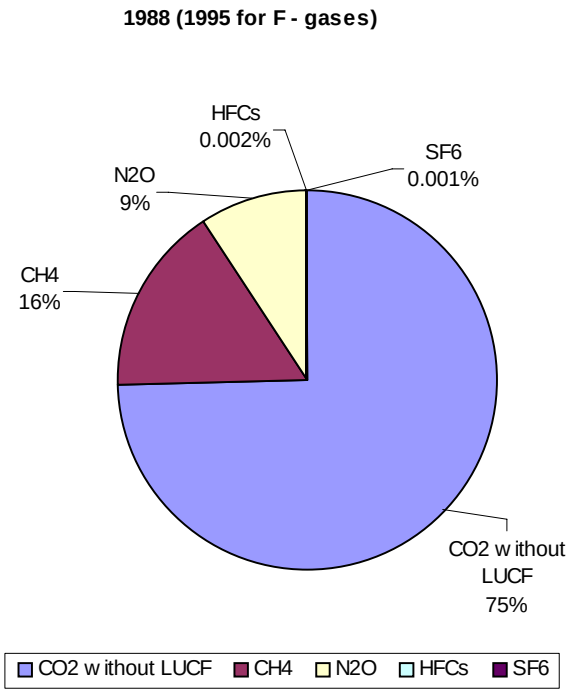
In **Table 2.1** are given emission trends of the main GHG, the summary emissions (without reporting of LUCF) and the overall emissions share of the emissions from the base year 1988, assumed as 100%.

Analysis of **Table 2.1** shows, that in 2006, CO_2 emissions headed the list with the biggest share – 77.19% of the overall GHG emissions, expressed in CO_2-eq., CH_4 emissions ranked the second place with 16.02%, and N_2O emissions ranked the third place with 5.93%. This distribution has undergone some changes compared to the base 1988, as it is shown in **Figure 2.1**.

Table 2.1 Summary of emission trends per gas, Gg

GHGs	CO_2 with LUCF	CO_2 without LULUCF	CH_4	N_2O	HFCs	PFC	SF6	Total	Index CO_2 without LULUCF	Index CH_4	Index N_2O	Index [group of six]	Index HFCs	Index PFC	Index SF_6
									Index 1988 = 100				Index 1995 = 100		
1988	93682	98815	21685	12114				**132614**	100	100	100	**100**			
1989	93429	99063	21493	11292				**131848**	100.25	99.12	93.21	**99.42**			
1990	80107	86269	19947	10501				**116716**	87.30	91.99	86.68	**88.01**			
1991	61139	68777	18724	7843				**95344**	69.60	86.35	64.74	**71.90**			
1992	54373	61785	17678	6426				**85889**	62.53	81.52	53.05	**64.77**			
1993	56900	64376	16494	5720				**86591**	65.15	76.06	47.22	**65.30**			
1994	55060	62361	15697	5855				**83913**	63.11	72.39	48.33	**63.28**			
1995	58837	66361	15757	5887	2.95		1.26	**88009**	67.16	72.66	48.60	**66.36**	100	NA,NE,NO	100
1996	58492	65010	15242	5806	109.30		1.31	**86167**	65.79	70.29	47.93	**64.98**	3700	NA,NE,NO	104
1997	56198	63070	14422	5453	188.15		1.75	**83136**	63.83	66.51	45.01	**62.69**	6370	NA,NE,NO	139
1998	48336	55197	14052	4451	576.66		1.83	**74277**	55.86	64.80	36.74	**56.01**	19523	NA,NE,NO	145
1999	43773	50973	13396	4524	102.80		1.88	**68998**	51.58	61.77	37.35	**52.03**	3480	NA,NE,NO	149
2000	41506	50482	13148	4966	96.02		2.23	**68695**	51.09	60.63	41.00	**51.80**	3251	NA,NE,NO	177
2001	42638	52105	12180	4624	97.50		2.29	**69009**	52.73	56.17	38.17	**52.04**	3301	NA,NE,NO	182
2002	40947	49265	12118	4500	89.59		2.51	**65975**	49.86	55.88	37.15	**49.75**	3033	NA,NE,NO	199
2003	46808	53864	12758	4492	120.60		2.52	**71237**	54.51	58.83	37.08	**53.72**	4083	NA,NE,NO	199
2004	45305	53270	12618	4439	217.30		3.68	**70548**	53.91	58.19	36.65	**53.20**	7357	NA,NE,NO	292
2005	47032	54028	11666	4411	386.84		4.42	**71455**	55.65	53.80	36.41	**53.88**	13096	NA,NE,NO	350
2006	48071	55067	11430	4230	610.68	0.04	5.30	**71343**	55.73	52.71	34.91	**53.80**	20674	100	420

Figure 2.1


1988 (1995 for F - gases)
HFCs
0.002%
SF6
0.001%
N2O
9%
CH4
16%
CO2 without
LUCF
75%
CO2 without LUCF
CH4
N2O
HFCs
SF6

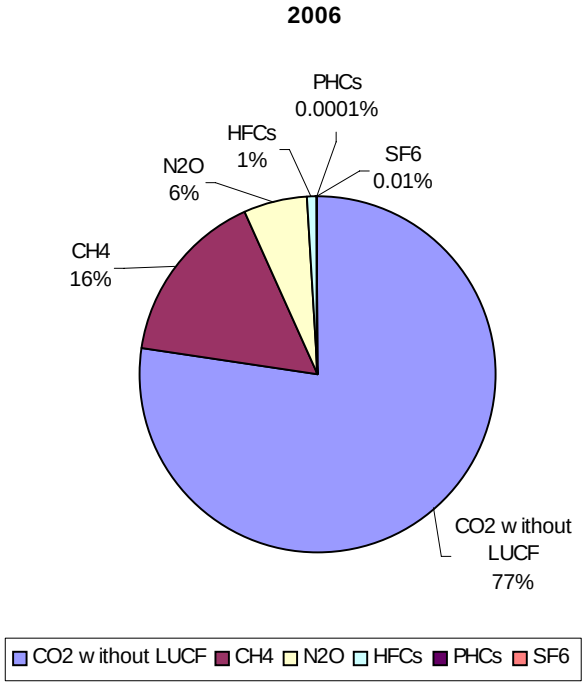
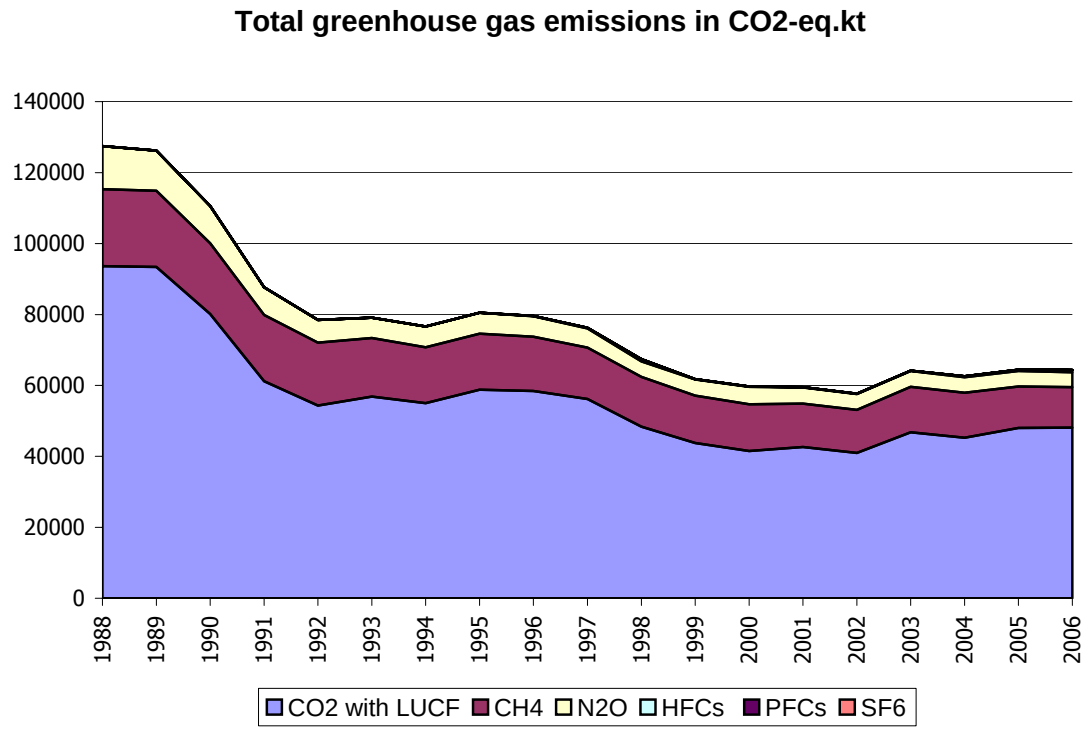

2006
PHCs
0.0001%
HFCs
1%
SF6
0.01%
N2O
6%
CH4
16%
CO2 without
LUCF
77%
CO2 without LUCF
CH4
N2O
HFCs
PHCs
SF6

Figure 2.2 shows the change in the overall emissions for the period 1988-2006

Figure 2.2



It can be seen that in 2006, the total GHG emissions in CO_2-eq., indicated a little increase. 2006 emissions were 53.80% from the emissions in the base year, 1988, and increase compared to the preceding 2005 by 1.2%. Detailed GHG emission trends by types of gases and source categories are given in **Annex 7**.

Table 2.2 shows the overall emissions by sectors for the period 1988-2006, in CO_2-eq. The quantities of CO_2, sequestrated by forestry, are also included (without F-gases).

Table 2.2 Aggregated GHG emissions by sector, Gg, CO_2-eq.

Sector/year	Energy	Industrial Processes	Solvent and Other Product Use	Agriculture	Forestry	Waste	Total (without LUCF)
1988	94666.4	10569.8	76.0	14559.0	-5132.6	12743.3	**132614**
1989	94763.2	10638.0	76.0	13778.4	-5629.3	12592.8	**131848**
1990	81465.3	9892.5	73.3	12953.2	-6157.0	12332.1	**116717**
1991	65770.3	7070.6	72.7	10528.8	-7635.7	11901.7	**95344**
1992	59673.5	5933.3	71.7	8524.8	-7412.0	11685.8	**85889**
1993	62163.4	5856.8	71.5	7150.1	-7475.8	11349.1	**86591**
1994	59091.2	7086.9	71.3	6591.2	-7301.7	11072.1	**83913**
1995	61974.4	8963.1	70.9	5935.3	-7524.5	11065.6	**88009**
1996	60772.5	8922.0	70.5	5696.1	-6517.5	10706.3	**86167**
1997	59044.4	8224.3	70.0	5590.8	-6871.5	10206.0	**83136**
1998	53616.9	5550.9	69.6	5309.4	-6860.5	9730.6	**74277**
1999	48852.4	5113.5	53.6	5666.1	-7199.8	9312.1	**68998**
2000	48177.6	6080.4	67.2	5394.1	-8976.2	8975.8	**68695**
2001	49772.7	6058.9	53.1	4540.7	-9467.1	8584.0	**69009**
2002	47328.4	5417.6	54.7	4859.3	-8318.1	8315.0	**65975**
2003	51469.4	6020.5	49.9	4832.7	-7056.0	8864.6	**71237**

2004	50661.9	6101.6	52.4	5081.0	-7965.2	8651.5	**70548**
2005	51228.3	6529.1	53.5	4804.0	-6996.0	7882.1	**70497**
2006	52204.1	6794.0	55.4	4720.1	-6996.0	7569.8	**71343**

Table 2.3 shows the shares in percentage of the overall GHG emissions by sectors for the period 1988-2006. This percent is calculated on the overall emissions, excluding CO_2 sequestration by forestry.

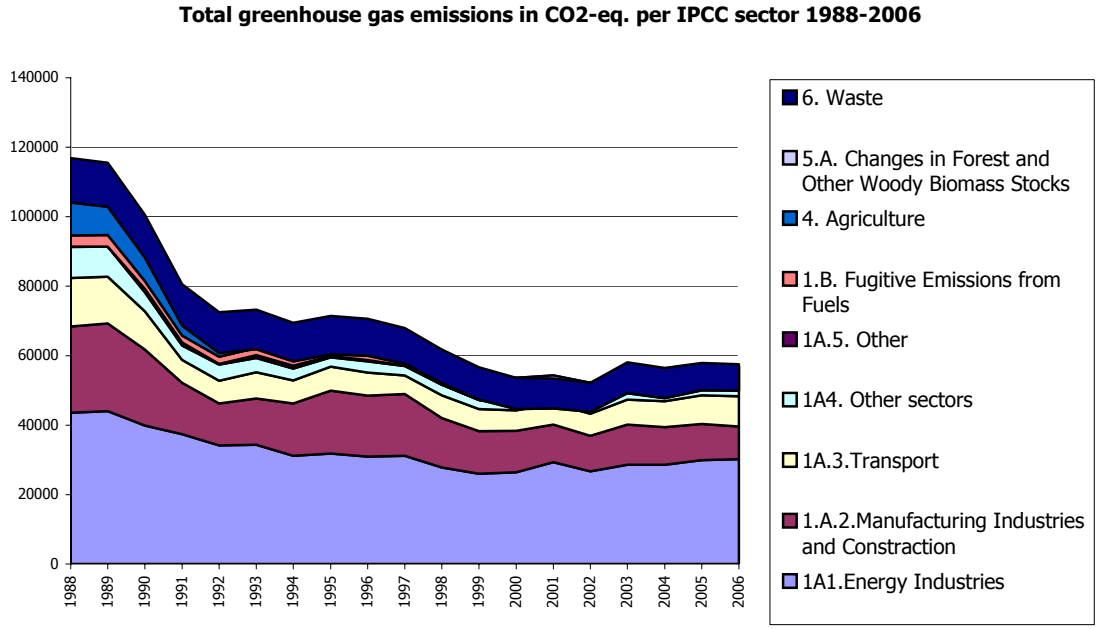
Table 2.3 Sector contribution in aggregated emissions, %

Sector/year	Energy	Industrial Processes	Solvent and Other Product Use	Agriculture	Forestry	Waste
1988	71.38	7.97	0.06	10.98	-3.87	9.61
1989	71.87	8.07	0.06	10.45	-4.27	9.55
1990	69.80	8.48	0.06	11.10	-5.28	10.57
1991	68.98	7.42	0.08	11.04	-8.01	12.48
1992	69.48	6.91	0.08	9.93	-8.63	13.61
1993	71.79	6.76	0.08	8.26	-8.63	13.11
1994	70.42	8.45	0.08	7.85	-8.70	13.19
1995	70.42	10.18	0.08	6.74	-8.55	12.57
1996	70.53	10.35	0.08	6.61	-7.56	12.43
1997	71.02	9.89	0.08	6.72	-8.27	12.28
1998	72.18	7.47	0.09	7.15	-9.24	13.10
1999	70.80	7.41	0.08	8.21	-10.43	13.50
2000	70.13	8.85	0.10	7.85	-13.07	13.07
2001	72.12	8.78	0.08	6.58	-13.72	12.44
2002	71.74	8.21	0.08	7.37	-12.61	12.60
2003	72.25	8.45	0.07	6.78	-9.90	12.44
2004	71.81	8.65	0.07	7.20	-11.29	12.26
2005	72.66	9.14	0.07	6.72	-9.79	11.03
2006	73.17	9.52	0.08	6.62	-9.81	10.61

Analysis of **Table 2.3** shows that sector Energy, where GHG emissions come from fuel combustion, headed the list in 2006 with the biggest share – 73.17%. Sector Waste ranked the second place with 10.61% and sector Industrial processes ranked the third place with 9.52%.

Figure 2.3 shows the aggregated GHG emissions by sectors according to the IPCC classification.

Figure 2.3



The aggregated GHG emission trend's uncertainty, according to the method Tier 1, was 3.9%. The level (quantity) uncertainty of the overall emissions was much larger and achieved about 13.3%. The last thing indicates that reporting the emissions in the base 1988 leads to lowering the uncertainty parameters compared to the reporting of emissions of the current year.

2.2. GHG Emission Trends by Gas

Table 2.4 shows the **CO_2 emission** trends by IPCC sectors.

Reduction of the CO_2 overall emissions in 2006 compared to the base 1988 was 46.2%. That reduction was conditioned mostly by the reduction in industry – 62%, in transport - 38%, and especially in households - 81%. The lowest reduction was in the Energy sector - 37%, due to the structure of the electrical production facilities, including the significant output of electrical power, produced in the Nuclear Power Plant – almost 4.5% more than 2005.

Compare to previous 2005 year, CO_2 emissions in current year have an increase of 1.2%.

Table 2.5 shows the **CH_4 emission** trends by IPCC sectors.

Reduction of the CH_4 overall emissions in 2006 compared to the base 1988 was 47.3%. That reduction is conditioned mostly by the reduction in agriculture – 66%, in fugitive emissions from coal mining and gas and oil systems - 45%, and particularly in the solid waste - 35%. The reduction in the wastewater treatment is essential - 69%. The indicated reductions describe best the processes of changes and restructuring of the agricultural production.

Compared to the preceding 2005, a reduction of CH_4 emissions can be seen in the current year for overall emissions of 2.0%, 0.5% growth in agriculture and 4% reduction in wastes.

Table 2.6 shows the N_2O emission trends by IPCC sectors.

The overall N_2O emission reduction in 2006, compared to the base 1988, was 65.1%. That reduction is conditioned mostly by the reduction in the industrial processes - 63%, and particularly in the agriculture – 68.8%. The indicated reductions describe best the processes of fertilizers and manure handling, and the reduction of plant crops.

Compared to the preceding 2005, a reduction of N_2O emissions can be seen in the current year as follows: overall reduction of 4.0%, 1.5% growth in energy sector, 9.3% reduction in industrial processes, and 3.3% reduction in agriculture. Main factor for the reduction in the agriculture is the reduced yields of plant crops.

The reduction in the Industrial sector is due to the decreased output of nitric acid during the current year.

Table 2.4 CO_2 emissions and sinks per IPCC sector 1988- 2006, Gg

Year	Total net national emissions incl. LUCF	Total net national emissions excl. LUCF	1. All energy (combustion and fugitive)	1A.Fuel Combustion	1A1a Electricity and heat production	1A1b Petroleum Refinery	1A1c Manufacture of Solid Fuels	1.A.2.Manufacturing Industries and Constriction	1A.3.Transport	1A4a. Commercial/ Institutional	1A4b. Residential	1A4c. Agriculture/ Forestry/Fishing	1A.5. Other	1.B. Fugitive Emissions from Fuels	2. Industrial Processes (ISIC)	3. Solvent and Other Product Use	5.A. Changes in Forest and Other Woody Biomass Stocks	6. Waste	CO_2 Marine	CO_2 Aviation
1988	93682	98815	90726	90726	43217	NO	NO	24755	13814	1068	6654	1219	NO	NA, NE	8066	23.1	-5133	NA,NE	969	749
1989	93429	99063	90789	90789	43690	NO	NO	25215	13245	773	6609	1256	NO	NA, NE	8252	23.1	-5629	NA,NE	987	731
1990	80107	86269	78673	78673	37939	356	1306	21821	10864	172	4787	422	1005.9	NA, NE	7574	22.2	-6157	NA,NE	874	892
1991	61139	68777	63357	63357	35823	362	921	14758	6525	124	3633	330	881.9	NA, NE	5398	22.1	-7636	NA,NE	878	320
1992	54373	61785	57197	57197	32882	58	922	12093	6435	107	4354	149	195.9	NA, NE	4566	21.8	-7412	NA,NE	873	565
1993	56900	64376	59682	59682	32969	59	1063	13296	7444	114	3890	114	733.1	NA, NE	4673	21.7	-7476	NA,NE	844	739
1994	55060	62361	56658	56658	29830	48	1067	15032	6547	96	2962	267	809.6	NA, NE	5681	21.6	-7302	NA,NE	850	632
1995	58837	66361	59376	59376	30350	51	1171	18023	6845	64	2456	102	315.0	NA, NE	6964	21.5	-7524	NA,NE	882	549
1996	58492	65010	58208	58208	29470	51	1131	17499	6559	114	3095	28	261.1	NA, NE	6780	21.4	-6517	NA,NE	732	472
1997	56198	63070	56703	56703	29929	51	957	17691	5285	46	2632	NO	112.2	NA, NE	6346	21.2	-6872	NA,NE	1092	428
1998	48336	55197	51235	51235	26458	NO	1044	14217	6478	288	2544	157	49.1	NA, NE	3941	21.1	-6860	NA,NE	1022	490
1999	43773	50973	46750	46750	24499	142	1120	12283	6215	503	1795	194	NO	NA, NE	4218	5.4	-7200	NA,NE	26	319
2000	41506	50482	45869	45869	24881	48	1286	11868	5889	330	1362	204	NO	NA, NE	4594	19.2	-8976	NA,NE	205	270
2001	42638	52105	47486	47486	27805	52	1179	10788	6024	574	884	180	NO	NA, NE	4613	6.4	-9467	NA,NE	306	393
2002	40947	49265	45066	45066	25201	48	1217	10198	6329	388	1511	174	NO	NA, NE	4191	8.5	-8318	NA,NE	336	399
2003	46808	53864	49180	49180	27264	42	1024	11533	7111	287	1741	178	NO	NA, NE	4679	3.9	-7056	NA,NE	436	485
2004	45305	53270	48289	48289	27043	53	1202	10818	7415	200	1354	204	NO	NA, NE	4975	6.7	-7965	NA,NE	366	405
2005	47032	54028	48921	48921	27263	49	1373	10421	8115	224	1241	235	NO	NA, NE	5099	8.0	-6996	NA,NE	349	473
2006	48071	55067	49823	49823	27425	51	1565	10264	8622	383	1295	219	NO	NA, NE	5234	10.2	-6996	NA,NE	338	484

Table 2.5 CH_4 emissions per IPCC sector 1988- 2006, Gg

IPCC Sector	TOTAL NET NATIONAL EMISSIONS	1. All energy (combustion and fugitive)	A. Fuel combustion total	1. Energy	2. Industry	3. Transport	4. Other sectors	5. Other	B. Fugitive fuel emissions	1. Solid fuels	2. Crude oil and natural gas	2. Industrial Processes	4. Agriculture	A. Enteric Fermentation	B. Manure Management	C. Rice Cultivation	D. Agricultural Soils	F. Field Burning of Agricultural Residues	6. Waste	A. Solid Waste Disposal on Land	B. Wastewater Handling
1988	1033	163	7.7	0.8	0.6	3.0	1.7	1.7	155.7	94.8	60.9	3.9	273.2	192.79	72.55	5.68	NA,NO	2.2	592.04	504.18	87.9
1989	1023	165	8.0	0.8	0.6	3.1	1.6	1.9	157.3	92.6	64.8	3.9	268.8	187.57	73.11	5.49	NA,NO	2.7	585.44	508.07	77.4
1990	950	112	6.9	0.9	0.4	2.9	1.1	1.6	105.2	75.8	29.4	3.0	258.1	180.17	71.49	4.26	NA,NO	2.2	576.59	510.08	66.5
1991	892	98	5.1	0.7	0.3	1.4	0.8	1.8	92.7	65.1	27.6	2.2	234.4	165.99	62.81	3.30	NA,NO	2.3	557.15	505.47	51.7
1992	842	101	5.2	0.7	0.3	1.7	1.0	1.6	95.6	71.5	24.1	2.1	192.0	137.48	51.10	1.82	NA,NO	1.6	546.88	499.63	47.3
1993	785	101	5.2	0.6	0.3	1.9	0.9	1.5	95.9	71.4	24.5	2.4	150.7	107.19	40.90	1.26	NA,NO	1.3	531.28	491.16	40.1
1994	747	99	5.3	0.5	0.3	1.9	1.0	1.6	93.8	66.7	27.1	3.2	126.6	90.13	34.72	0.33	NA,NO	1.4	518.55	481.26	37.3
1995	750	106	5.8	0.6	0.3	2.0	1.3	1.6	100.3	69.2	31.1	3.5	121.8	85.27	34.52	0.56	NA,NO	1.5	518.89	469.55	49.3
1996	726	105	5.7	0.5	0.3	1.7	1.6	1.6	98.8	67.3	31.4	3.3	115.8	82.38	31.60	1.05	NA,NO	0.8	502.17	455.31	46.9
1997	687	94	5.4	0.5	0.3	1.3	1.6	1.7	88.4	60.7	27.7	3.5	110.3	79.48	27.93	1.53	NA,NO	1.3	479.18	439.39	39.8
1998	669	96	7.3	0.5	0.3	1.4	3.5	1.5	88.9	63.7	25.1	3.0	114.2	81.77	29.64	1.61	NA,NO	1.2	455.76	421.43	34.3
1999	638	84	7.2	0.4	0.3	1.5	3.5	1.6	77.1	56.0	21.1	2.8	115.1	82.95	30.30	0.57	NA,NO	1.3	435.60	405.49	30.1
2000	626	94	8.2	0.4	0.2	1.4	4.7	1.4	85.4	57.1	28.3	3.5	108.9	79.28	27.08	1.44	NA,NO	1.1	420.01	391.74	28.3
2001	580	92	7.8	0.5	0.2	1.3	4.4	1.4	83.7	57.7	26.0	2.4	84.4	62.20	19.30	1.57	NA,NO	1.3	401.70	378.77	22.9
2002	577	91	8.9	0.4	0.2	1.4	5.3	1.6	82.2	58.5	23.7	2.2	95.0	68.97	22.42	2.11	NA,NO	1.5	388.78	367.00	21.8
2003	608	91	9.0	0.5	0.2	1.4	5.6	1.3	81.8	57.5	24.2	2.8	99.1	71.52	24.38	2.27	NA,NO	0.9	414.93	356.45	58.5
2004	601	95	9.3	0.4	0.2	1.3	5.8	1.6	85.5	58.7	26.8	2.3	98.9	70.95	24.05	2.30	NA,NO	1.6	404.84	346.12	58.7
2005	556	92	9.1	0.5	0.2	1.4	5.5	1.5	82.6	52.7	29.9	2.2	93.3	67.34	22.75	1.89	NA,NO	1.3	368.33	337.24	31.1
2006	544	95	9.5	0.5	0.2	1.5	5.9	1.4	85.4	56.5	28.9	2.1	93.7	67.33	23.08	2.05	NA,NO	1.2	353.57	326.05	27.5

Table 2.6 N_2O emissions per IPCC sector 1988- 2006, Gg

IPCC Sector	TOTAL NET NATIONAL EMISSIONS	1. All energy (combustion and fugitive)	A. Fuel combustion total	1a Electricity and heat production	1bc. Other transformation	2. Industry	3. Transport	4. Other Sectors	5. Other	B. Fugitive fuel emissions	2. Industrial Processes (ISIC)	3. Solvent and Other Product Use	4. Agriculture	A. Enteric Fermentation	B. Manure Management	C. Rice Cultivation	D. Agricultural Soils	F. Field Burning of Agricultural Residues	6. Waste
1988	39.08	1.64	1.64	0.97	NO	0.14	0.33	0.16	0.03	NA,NE	7.81	0.17	28.46		3.41		25.00	0.05	1.00
1989	36.43	1.62	1.62	1.00	NO	0.13	0.31	0.15	0.04	NA,NE	7.43	0.17	26.24		3.41		22.77	0.06	0.96
1990	33.87	1.41	1.41	0.80	0.004	0.21	0.25	0.10	0.04	NA,NE	7.28	0.16	24.30		3.32		20.93	0.05	0.72
1991	25.30	1.16	1.16	0.79	0.004	0.09	0.15	0.07	0.05	NA,NE	5.25	0.16	18.08		2.97		15.06	0.05	0.65
1992	20.73	1.16	1.16	0.81	0.004	0.08	0.14	0.08	0.04	NA,NE	4.27	0.16	14.49		2.45		12.01	0.04	0.65
1993	18.45	1.16	1.16	0.80	0.004	0.08	0.17	0.07	0.04	NA,NE	3.65	0.16	12.86		1.96		10.88	0.02	0.62
1994	18.89	1.13	1.13	0.79	0.004	0.10	0.14	0.06	0.04	NA,NE	4.32	0.16	12.69		1.64		11.02	0.03	0.59
1995	18.99	1.20	1.20	0.83	0.004	0.11	0.14	0.06	0.04	NA,NE	6.20	0.16	10.89		1.60		9.27	0.03	0.54
1996	18.73	1.19	1.19	0.82	0.005	0.11	0.14	0.08	0.04	NA,NE	6.33	0.16	10.53		1.49		9.02	0.02	0.52
1997	17.59	1.20	1.20	0.85	0.004	0.13	0.12	0.07	0.04	NA,NE	5.21	0.16	10.56		1.36		9.18	0.03	0.46
1998	14.36	1.17	1.17	0.80	0.004	0.09	0.13	0.11	0.03	NA,NE	3.12	0.16	9.39		1.46		7.91	0.02	0.52
1999	14.59	1.07	1.07	0.72	0.004	0.07	0.13	0.10	0.03	NA,NE	2.36	0.16	10.48		1.51		8.95	0.03	0.53
2000	16.02	1.10	1.10	0.75	0.004	0.07	0.13	0.12	0.03	NA,NE	4.24	0.15	10.02		1.38		8.61	0.02	0.50
2001	14.92	1.18	1.18	0.83	0.004	0.07	0.14	0.11	0.03	NA,NE	4.18	0.15	8.93		1.03		7.88	0.02	0.48
2002	14.52	1.13	1.13	0.74	0.003	0.07	0.15	0.13	0.03	NA,NE	3.51	0.15	9.24		1.19		8.03	0.03	0.49
2003	14.49	1.24	1.24	0.82	0.003	0.08	0.17	0.14	0.03	NA,NE	3.74	0.15	8.88		1.27		7.59	0.02	0.49
2004	14.32	1.23	1.23	0.81	0.003	0.07	0.18	0.14	0.03	NA,NE	2.77	0.15	9.69		1.26		8.40	0.03	0.48
2005	14.23	1.23	1.23	0.79	0.004	0.06	0.20	0.13	0.03	NA,NE	3.20	0.15	9.18		1.19		7.96	0.02	0.47
2006	13.64	1.25	1.25	0.80	0.004	0.06	0.21	0.14	0.03	NA,NE	2.90	0.15	8.88		1.18		7.67	0.02	0.47

Table 2.7 shows the actual emissions **of F-gases.**

In 2006 there is some changes of the overall F-gases emissions, compared to the base 1995. During 2006 have been imported a large quantity of F-gases. It is due to the fact that a lot of ozone depletion substances are replaced with F-gases. Still there is not production of primary aluminum in the country. There is casting of aluminum products, which is classified as production of secondary aluminum.

Table 2.7 Actual and potential emissions of HFCs, PFCs, SF_6, Gg CO_2-eq.

New gases/ Year	Total HFCs	Total PFCs	SF_6	HFCs- potential	PFCs-potential	SF6-potential
1995	2.95	-	1.26	62.16	-	-
1996	-	-	1.31	109.30	-	-
1997	-	-	1.75	188.15	-	-
1998	-	-	1.83	576.66	-	-
1999	-	-	1.88	102.80	-	-
2000	-	-	2.23	96.02	-	29.4
2001	-	-	2.29	97.50	-	2.39
2002	-	-	2.51	89.59	-	2.39
2003	-	-	2.52	120.60	-	6.36
2004	-	-	3.68	217.30	-	-
2005	-	-	4.42	386.84	-	0.96
2006	-	-	5.30	610.68	0.04	4.83

2.3. GHG Emission Trends by Source Categories

Table 2.8 shows the GHG aggregated emission trends by IPCC sectors. Obviously, sector Energy had the biggest contribution to the overall emissions, expressed in CO_2-eq. Sector Industrial processes (especially after 2000) and sectors Waste and Agriculture followed it.

Energy

A steady trend towards emission reduction in this sector has been observed since 1988. The highest reduction was in the public sector (including households) - 81%, industry - 62%, and transport - 38%, and the lowest in the power engineering - 37%.

Compared to the preceding 2005, a growth of emissions of all categories in the energy sector can be seen in 2006, except for industry. Chapter 3 of this Report contains a more detailed analysis of GHG emissions in the sector.

Industrial Processes

A steady trend towards emission reduction in this sector is observed since 1988. The highest reduction was with N_2O - 63%, CH_4 – 45% and with CO_2 it was 35%. The reporting of the potential emissions of HFCs in the new gases leads to an increase compared to the base year for them 1995.

Compared to the preceding 2005, a growth of 4.0% of the overall emissions of the sector can be seen in 2006. This growth is due to the increase of emissions of CO_2 because of the changed emission factor in ammonia production. Chapter 4 of this Report contains a more detailed analysis of GHG emissions in the sector.

Agriculture

The overall emission reduction in the sector has amounted to 68% since 1988. Emissions of all categories in this sector reduced at the rate of the same percent.

Compared to 2005, a reduction of emissions in the sector can be seen in 2006 by 2.0%. It breaks the trend of stable annual growth after 2000. Chapter 6 of this Report contains a more detailed analysis of GHG emissions in the sector.

Land-Use Change and Forestry

The annual CO_2 sequestration was about 7 - 9 million tones for the period after 1988. Chapter 7 of this Report contains a more detailed analysis of GHG emissions in the sector.

Waste

The total sector emission reduction from the base year until now was 41%. This reduction described best the emission reduction from solid waste, which was about 35%.

During the current year, the emissions from the sector were reduced by 4.0%, compared to 2005. It is due to the change of the method from Tier 1 to Tier 2. Chapter 8 of this Report contains a more detailed analysis of GHG emissions in the sector.

International Bunkering

International bunkering emissions of marine and air transport are reported separately from the overall emissions of the country. Compared to the base year, their reduction was by 52%.

Table 2.8 Summary of emission trend per source category and gas, Gg CO_2-eq.

Source category	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. All energy	94666	94763	81465	65770	59674	62163	59091	61974	60773	59044
1A. Energy: fuel combustion	91396	91459	79256	63823	57666	60150	57121	59869	58698	57188
CO_2: 1. Energy industries	43217	43690	39601	37106	33862	34092	30945	31572	30652	30936
CO_2: 2. Industry	24755	25215	21821	14758	12093	13296	15032	18023	17499	17691
CO_2: 3. Transport	13814	13245	10864	6525	6435	7444	6547	6845	6559	5285
CO_2: 4. Other sectors	8940	8639	5381	4086	4610	4117	3325	2621	3238	2678
CO_2: 5. Other	NO	NO	1006	882	196	733	810	315	261	112
CH_4	162.2	167.6	145.4	107.6	109.3	108.6	111.6	122.4	120.5	113.7
N_2O	508.0	502.8	437.9	359.1	359.3	359.7	351.5	370.6	370.0	371.6
B. Fugitive fuel emissions	3271	3304	2209	1947	2007	2013	1970	2106	2074	1857
CH_4	3271	3304	2209	1947	2007	2013	1970	2106	2074	1857
N_2O	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2. Industrial Processes (ISIC)	10570	10638	9893	7071	5933	5857	7087	8963	8922	8224
CO_2	8066	8252	7574	5398	4566	4673	5681	6964	6780	6346
CH_4	82	82	63	46	44	51	68	74	69	74
N_2O	2422	2305	2255	1626	1324	1133	1338	1921	1962	1614
HFCs								62	109	188
PFCs										
SF6								1.26	1.31	1.75
3. Solvent and Other Product Use	76.0	76.0	73.3	72.7	71.7	71.5	71.3	70.9	70.5	70.0
CO_2	23.1	23.1	22.2	22.1	21.8	21.7	21.6	21.5	21.4	21.2
N_2O	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
4. Agriculture	14559	13778.4	12953.2	10528.8	8524.76	7150.11	6591.2	5935.33	5696.14	5590.83
CH_4 Enteric fermentation	4049	3939	3784	3486	2887	2251	1893	1791	1730	1669
CH_4 Manure management	1524	1535	1501	1319	1073	859	729	725	664	587
CH_4 Rice cultivation	119	115	90	69	38	26	7	12	22	32
CH_4 Field Burning of Agricultural Residues	46.35	55.78	46.25	48.74	34.06	27.84	29.43	30.69	16.93	28.12
N_2O Manure Management	1056	1057	1030	921	760	606	510	496	461	422
N_2O Agricultural soils	7750	7057	6488	4668	3722	3372	3415	2872	2797	2845
N_2O Field Burning of Agricultural Residue	4680	5737	4335	5111	3405	2365	2466	2887	1708	2471
5. LULUCF	-5132.6	-5629.3	-6157	-7635.7	-7412	-7475.8	-7301.7	-7524.5	-6517.5	-6871.5
CO_2	-5132.6	-5629.3	-6157	-7635.7	-7412	-7475.8	-7301.7	-7524.5	-6517.5	-6871.5
6. Waste	12743	12593	12332	11902	11686	11349	11072	11066	10706	10206
CO_2	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
CH_4	12433	12294	12108	11700	11484	11157	10890	10897	10546	10063
N_2O	310	299	224	202	201	192	183	169	161	143
7. Other										
NATIONAL TOTAL EMISSIONS	132614	131848	116716	95344.1	85889.1	86591	83912.7	88009.2	86167.5	83135.5
International bunker	1727	1727	1774	1206	1446	1590	1490	1439	1210	1529

Source category	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. All energy	53617	48852	48178	49773	47328	51469	50662	51228	52204
1A. Energy: fuel combustion	51751	47232	46384	48014	45603	49752	48867	48921	49823
CO_2: 1. Energy industries	27502	25760	26216	29036	26466	28330	28298	28685	29041
CO_2: 2. Industry	14217	12283	11868	10788	10198	11533	10818	10421	9329
CO_2: 3. Transport	6478	6215	5889	6024	6329	7111	7415	8115	8622
CO_2: 4. Other sectors	2989	2491	1896	1638	2074	2206	1758	1700	1897
CO_2: 5. Other	49	NO	NO	NO	NO	NO	NO	NO	NO
CH_4	152.7	152.2	171.9	163.3	186.8	188.3	196.3	190.6	199.7
N_2O	363.0	330.7	342.4	365.1	350.1	383.4	381.6	381.1	387.9
B. Fugitive fuel emissions	1866	1620	1794	1759	1725	1717	1795	1735	1793
CH_4	1866	1620	1794	1759	1725	1717	1795	1735	1793
N_2O	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
2. Industrial Processes (ISIC)	5551	5113	6080	6059	5418	6021	6102	6529	6794
CO_2	3941	4218	4594	4613	4191	4679	4975	5099	5234
CH_4	63	58	74	51	46	59	48	46	45
N_2O	968	732	1314	1295	1089	1159	858	992	900
HFCs	577	103	96	98	90	121	217	387	611
PFCs									0.04
SF6	1.83	1.88	2.23	2.29	2.51	2.52	3.68	4.42	5.30
3. Solvent and Other Product Use	69.6	53.6	67.2	53.1	54.7	49.9	52.4	53.5	55.4
CO_2	21.1	5.4	19.2	6.4	8.5	3.9	6.7	8.0	10.2
N_2O	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4. Agriculture	5309.36	5666.09	5394.07	4540.66	4859.32	4832.73	5081.04	4804.03	4720.07
CH_4 Enteric fermentation	1717	1742	1665	1306	1448	1502	1490	1414	1414
CH_4 Manure management	623	636	569	405	471	512	505	478	485
CH_4 Rice cultivation	34	12	30	33	44	48	48	40	43
CH_4 Field Burning of Agricultural Residues	24.96	27.36	24.15	27.32	31.55	19.01	33.80	27.10	26.13
N_2O Manure Management	452	467	429	321	368	395	390	369	366
N_2O Agricultural soils	2452	2773	2671	2442	2488	2352	2604	2468	2379
N_2O Field Burning of Agricultural Residue	2184	2598	1941	1963	2529	1841	2961	2335	2283
5. LULUCF	-6860.5	-7199.8	-8976.2	-9467.1	-8318.1	-7056	-7965.2	-6996	-6996
CO_2	-6860.5	-7199.8	-8976.2	-9467.1	-8318.1	-7056	-7965.2	-6996	-6996
6. Waste	9731	9312	8976	8584	8315	8865	8651	7882	7570
CO_2	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
CH_4	9571	9148	8820	8436	8164	8713	8502	7735	7425
N_2O	160	164	156	148	151	151	150	147	145
7. Other									
NATIONAL TOTAL EMISSIONS	74277.4	68997.6	68695.1	69009.4	65975.1	71237.1	70548.4	71455	71342.6
International bunker	1521	345	477	702	739	925	775	826	823

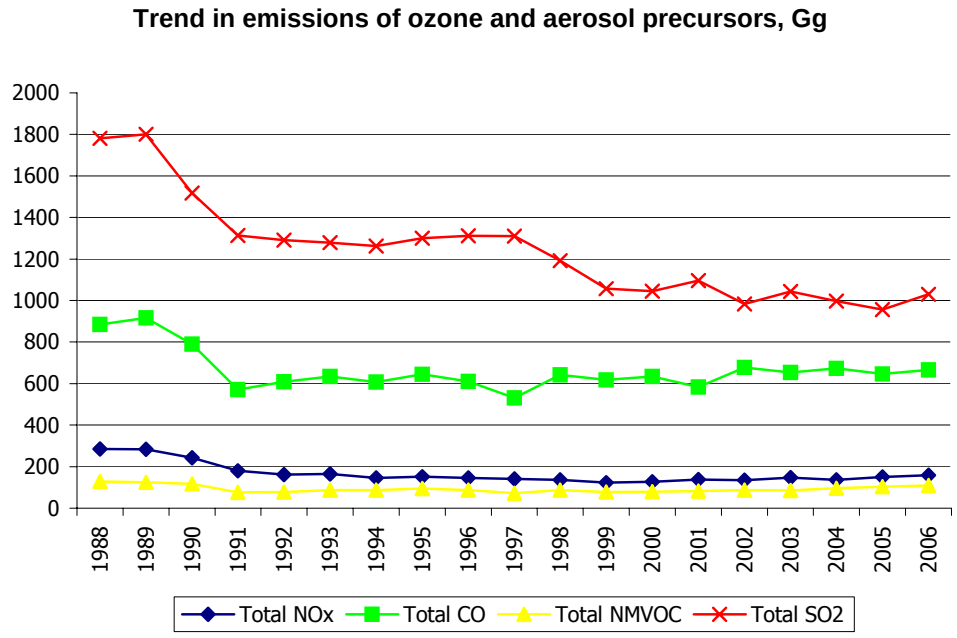
2.4. Emissions Trends of GHG-Precursors and SOx

Table 2.9 shows the GHG-precursors aggregated emission trends. As a whole, the emissions from all gases decreased in the period after the base 1988.

Table 2.9 Trend in emissions of ozone and aerosol precursors, 1988-2006, Gg

Emissions/ Year	NOx	Index total NOx (1988=100)	CO	Index total CO (1988=100)	NMVOC	Index total NMVOC (1988=100)	SO_2	Index total SO_2 (1988=100)
1988	284.87	100	884.51	100	128.99	100	1781	100
1989	283.44	99	916.72	104	124.08	96	1800	101
1990	242.26	85	789.67	89	117.48	91	1517	85
1991	179.36	63	571.62	65	76.92	60	1313	74
1992	161.96	57	609.05	69	78.53	61	1291	72
1993	165.34	58	634.05	72	86.37	67	1279	72
1994	146.12	51	607.55	69	86.67	67	1262	71
1995	151.45	53	644.37	73	94.45	73	1300	73
1996	144.89	51	609.81	69	87.00	67	1311	74
1997	140.62	49	531.04	60	72.47	56	1311	74
1998	135.75	48	640.93	72	87.49	68	1192	67
1999	123.40	43	618.00	70	78.28	61	1056	59
2000	127.77	45	634.83	72	78.90	61	1045	59
2001	137.60	48	583.00	66	81.80	63	1096	62
2002	134.41	47	677.93	77	87.41	68	983	55
2003	146.63	51	654.03	74	85.63	66	1043	59
2004	136.79	48	673.83	76	95.53	74	998	56
2005	149.57	53	646.20	73	102.83	80	957	54
2006	159.04	56	665.31	75	108.85	84	1030	58

Figure 2.4 shows changes of GHG-precursors emission trends



Analysis of **Figure 2.4** shows a trend towards stable emissions in the period after 1999.The biggest are the fluctuations in SOx emissions, where desulphurisation plants have significant influence.

NOx Emissions

Overall NOx emissions for the country in 2006 were 159 Gg. Compared to 2005, an increase of the emissions by 6.3% could be seen.

Sector Energy was a main source of NOx emissions in Bulgaria. It emitted 94% of the overall NOx emissions in 2006. The main part of emissions in this sector came from sub-sectors Energy industries and Transport – over 80% of the emissions in the sector in total.

CO Emissions

Overall CO emissions for the country in 2006 were 665.3 Gg. Compared to 2005, a reduction by 3.0% could be seen.

Sector Energy was a main source of CO emissions in Bulgaria, and it emitted 95% of the overall emissions in the country, including 44% from the Public sub-sector. The emissions from this sector are bigger than sub-sector Transport because of the increase of the emission factor from household biomass combustion.

Sector Agriculture covers 4.0% from the total CO emissions in Bulgaria. They are 3.6% less than the level in 2004 because of the more unfavourable climate conditions in food and other crop production.

NMVOCs Emissions

The NMVOC emitters for Bulgaria were sectors: Energy, Industrial processes and Solvent and Other Product Use.

Overall emissions for the country in 2006 were 108.9 Gg. The emissions' increase, compared to 2005, was 5.9%.

Sector Energy was a main source of NMVOC emissions in Bulgaria, and it emitted 59.9 Gg in 2006. This is 55% of the overall NMVOC emissions in the country. Almost 2/3 of them come from sub-sector Transport.

Sector Solvent and Other Product Use was the third largest NMVOC emission source in Bulgaria, with 32.5% of the overall emissions in the country.

SOx Emissions

The SOx emitters for Bulgaria were sectors: Energy and Industrial processes.

Overall emissions in 2006 were 1030 Gg (with the consideration of the desulphurization of output gases in thermo-electric power plants the emissions are with 169.203 Gg lower). The emissions' growth, compared to 2005, was 7.6%.

Sector Energy was a main source of SOx emissions in Bulgaria. It emitted over 98% of the overall SOx emissions in 2006. The main part of emissions in this sector came from sub-sector Energy industries – 897 Gg in 2006.

The second largest SOx emission source was sub-sector Manufacturing industries and construction, with 5.9%, and on third place – sector Other sectors, with 3.8%.

CHAPTER 3 ENERGY

3.1. Overview

In accordance to the IPCC classification, the **Energy sector** comprises of emissions resulting from end-use fuel combustion as well as fugitive emissions from extraction, transmission and distribution of solid, liquid and gaseous fuels are also included in this sector.

Combustion processes emissions are divided to the following sub-sectors according to the IPCC structure:

- Energy Industries;
- Manufacturing industries and construction;
- Transport;
- Other sectors (Commercial, Households, Agriculture and Forestry);
- Other.

The fugitive emissions are:

- Coal mining;
- Extraction, transportation and distribution of petrol products and natural gas.

The Energy sector in Bulgaria holds a key position in the national economy. It was the source of over 74% of the aggregated GHG emissions for the last inventory 2006.

Table 3.1 shows CO_2 emission trends of the above sub-sectors for the period 1988 - 2006.

The analysis of **Table 3.1** shows that the **Energy Industries** kept the largest share - over 41% of the overall emissions in this sector. It was the only sector, where an increase of the relative share compared to the base 1988, it can be observed – from 47.6% up to 60% in 2006. For all other sectors this share decreased: manufacturing industries from 27 down to 18%, transport from 15 up to 17%, and especially in the public sector and households – from 9.8 down to 3.8%. The last figure can be assumed as a positive result from the reduced direct fuel combustion in the households, which led to an overall GHG emission and air pollutants' reduction.

The emissions growth in the energy industries, compared to the preceding year, can be observed only in energy and transport.

The trend of **Transport** sector shows increase with 6.2% in 2006 compared to the previous year. Despite the fluctuations resulted from variations of liquid fuel prices, and from restructuring and renovation of the vehicles after 2000 as well, there is a stable tendency for growth of emissions.

The overall trends in sub-sector **Other sectors** (Commercial, Households, Agriculture and Forestry) displayed fluctuations as well.

CO_2 emissions from biomass combustion are not taken into account because these were not included in the net GHG overall emissions.

Emissions from Sector Energy are assessed by data from the National energy balance of the country. This balance summarized all balances of companies and other large GHG

sources at national level. The methodology of GHG emission calculation is presented in Annex 2 to this Report.

CO_2 emissions from non-energy use of fuels are reported in this sector and not in sector Industrial Process because they belong exactly to this sector.

The fugitive emissions from coal mining, from extraction, transmission and distribution of petrol products and natural gas are also part of this sector.

The coal mining in Bulgaria is concentrated mainly in MARITZA IZTOK Mines, where lignite is mined in surface mines. These mines produce about 40% of the electrical power in the country. Brown and black coal mining has significantly less share.

Extraction of petrol products and natural gas in the country reported for less that 1% of the overall consumption. Due to its geographic location, a significant natural gas transits run across Bulgaria. They were about 3 times larger than the overall consumption of the country and lead to the corresponding increase of methane fugitive emissions.

Table 3.1 Trends in greenhouse gas emissions from Energy sector, Gg CO_2-eq.

Year	IPCC Source Category										
			CO_2					CH_4	N_2O	1B2. Fugitive Fuel Emissions	
	1. All (Energy Combustion and Fugitive)	1.A.Energy Fuel Combustion	Energy Industries	Industry	Transport	Other Sectors	Other			CH_4	N_2O
1988	**94 666**	91 396	43 217	24 755	13 814	8 940	NO	162	508	3 271	NA, NE
1989	**94 763**	91 459	43 690	25 215	13 245	8 639	NO	168	503	3 304	NA, NE
1990	**81 466**	79 257	39 601	21 821	10 864	5 381	1 006	145	438	2 209	NA, NE
1991	**65 771**	63 824	37 106	14 758	6 525	4 086	882	108	360	1 947	NA, NE
1992	**59 674**	57 666	33 862	12 093	6 435	4 610	196	109	359	2 007	NA, NE
1993	**62 163**	60 150	34 092	13 296	7 444	4 117	733	109	360	2 013	NA, NE
1994	**59 091**	57 121	30 945	15 032	6 547	3 325	810	112	352	1 970	NA, NE
1995	**61 974**	59 869	31 572	18 023	6 845	2 621	315	122	371	2 106	NA, NE
1996	**60 773**	58 698	30 652	17 499	6 559	3 238	261	120	370	2 074	NA, NE
1997	**59 044**	57 188	30 936	17 691	5 285	2 678	112	114	372	1 857	NA, NE
1998	**53 617**	51 751	27 502	14 217	6 478	2 989	49	153	363	1 866	NA, NE
1999	**48 853**	47 233	25 760	12 283	6 215	2 491	NO	152	331	1 620	NA, NE
2000	**48 178**	46 384	26 216	11 868	5 889	1 896	NO	172	342	1 794	NA, NE
2001	**49 773**	48 014	29 036	10 788	6 024	1 638	NO	163	365	1 759	NA, NE
2002	**47 328**	45 603	26 466	10 198	6 329	2 074	NO	187	350	1 725	NA, NE
2003	**51 469**	49 752	28 330	11 533	7 111	2 206	NO	188	383	1 717	NA, NE
2004	**50 662**	48 867	28 298	10 818	7 415	1 758	NO	196	382	1 795	NA, NE
2005	**51 228**	49 493	28 941	10 445	8 208	1 858	NO	191	381	1 735	NA, NE
2006	**52 204**	50 411	29 301	10 288	8 719	2 066	NO	200	388	1 793	NA, NE

Key Sources

Table 3.2 shows the basic (key) and non-key GHG sources in sector Energy.

Table 3.2. Key sources in Energy sector (Methods Tier 1)

IPCC Source category		Key sources
1	Public Electricity and Heat Production - Solid Fuels	Yes
2	Public Electricity and Heat Production - Liquid Fuels	Yes
3	Public Electricity and Heat Production - Gaseous Fuels	Yes
4	Road Transportation - Gasoline	Yes

5	Road Transportation - Diesel Oil	Yes
6	Road Transportation - LPG	Yes
7	Other Transportation - Liquid Fuels	Yes
8	Manufacturing Industries and Construction - Solid Fuels	Yes
9	Manufacturing Industries and Construction - Liquid Fuels	Yes
10	Manufacturing Industries and Construction - Gaseous Fuels	Yes
11	Manufacturing Industries and Construction - Solid Fuels	Yes
12	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	Yes
13	Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	Yes
14	Residential - Solid Fuels	Yes
15	Residential - Liquid Fuels	Yes
16	Fugitive Emissions from Fuels - Solid Fuels	Yes
17	Fugitive Emissions from Fuels - Oil and Natural Gas	Yes

CO_2 Emissions from Biomass

The biomass fuels in Bulgaria have been used mainly in the public sector, households and the agriculture, for the purposes of heat production, hot water and cooking. Biomass means firewood, wood processing waste, and waste biomass from forestry.

Table 3.3 shows CO_2 emissions at biomass combustion in the different sector categories.

Analysis of **Table 3.3** displayed a steady trend of biomass consumption growth since 1988 to the present. CO_2 emissions increased 2-3 times in 2006 compared to 1988. This growth was realized mainly in households, which held the largest share, namely 73.5% from the overall CO_2 emissions from biomass in 2006. The household emissions share is doubled compared to the base 1988.

3.2. Fuel Combustion

CO_2 emissions are calculated following the two methods, given below:

• "Top - down" (Reference approach) which deals with the apparent fuel consumption, taking into account the carbon flows into and of the country and stock changes;

• "Bottom - up" (Sectoral approach) which deals with the fuel consumption by sectors, sources and technology types that emit GHG.

Fuel combustion emissions are given in **Table 3.4.** The reduction trend of main GHG emissions was kept until 2000. Then emission fluctuations can be seen, with trend towards growth. CO_2 emissions in 2006 are reduced by 45%, compared to 1988. The corresponding reduction of CH_4 emissions was 43.9%, and of N_2O emissions by 25%.

The uncertainty assessment of GHG emissions from fuel combustion is on the basis of the uncertainties of fuel quantities and the emission factors for stationary and mobile combustion processes. These uncertainties are estimated at about 6-9% for CO_2 emissions, 50-100% for CH_4 emissions and 100-200% for N_2O emissions.

Electrical power and heat production had the biggest share of CO_2 emissions from fuel combustion – 58%. Manufacturing industries ranked the second place by 20%, followed by transport – 17%.

CH_4 and N_2O emissions were considerably lower than CO_2 emissions, as their overall share in the total emissions (in CO_2-eq.) from fuel combustion was less than 5 %.

The Energy balance of the country contains all primary and secondary fuels, used for energy needs and for non-energy consumption.

The help of conversion factors made fuel conversion from natural units into energy units, specific for the country. Database for the annual GHG inventory included both natural and energy units, by means of which the current conversion factors were determined. These factors are elements of the input data control system. The GHG emissions are calculated by the following base equation according to sectoral approach:

$$\text{Emissions} = \sum (EF_{abc} * \text{Source}_{abc}),$$

where:

EF – emission factor [kg/TJ]
Source = Energy flow [TJ]
a – fuel type
b – sector type (sub-sector or group)
c – technology type

Table 3.3 Organic CO_2 emissions (Gg) reported as "CO_2 from biomass" (from CRF 1A combustion)

	Energy Industries	Manufacturing Industries and Construction	Transport	Other Sectors	Commercial/ Institutional	Residential	Agriculture/Forestry/Fishing	Other	Fuel Combustion
	1.A.1	1.A.2	1A.3	1.A.4	1.A.4a	1.A.4b	1.A.4c	1.A.5	1.A
1988	IE	54.7	NO	572	68.5	467.9	36.0	716.8	1344
1989	IE	52.4	NO	568	65.1	467.6	35.4	816.8	1437
1990	IE	56.0	NO	413	17.0	365.3	30.7	683.1	1152
1991	IE	36.6	NO	324	13.5	290.2	19.9	769.0	1129
1992	IE	42.9	NO	409	15.0	368.0	26.0	667.7	1120
1993	IE	21.6	NO	361	10.6	346.7	3.5	631.4	1014
1994	IE	25.5	NO	423	11.6	397.4	13.9	671.3	1120
1995	IE	26.6	NO	556	11.4	540.9	3.4	663.9	1246
1996	IE	23.0	NO	668	5.7	662.3	0.0	681.7	1373
1997	IE	17.3	NO	685	7.8	676.9	0.0	731.7	1434
1998	IE	95.1	NO	1444	94.2	1346	3.8	660.3	2199
1999	IE	100.5	NO	1442	51.4	1349	42.5	666.1	2209
2000	IE	118.4	NO	1984	36.5	1893	55.0	602.5	2705
2001	IE	177.3	NO	1873	33.1	1834	5.9	588.3	2638
2002	IE	191.7	NO	2244	30.1	2205	9.1	672.2	3108
2003	IE	241.6	NO	2348	48.8	2288	11.9	541.1	3131
2004	IE	259.6	NO	2435	33.8	2388	12.8	696.6	3391
2005	IE	190.5	NO	2331	51.0	2260	20.0	625.0	3146
2006	IE	193.1	NO	2473	68.6	2393	11.3	587.5	3254

Table 3.4 Emissions and sinks for Energy sector 1988-2006, Gg

IPCC Sector	All energy	Fuel combustion total	Energy	Industry	Transport	Other sectors	Commercial/ Institutional	Residential	Agriculture/ Forestry/ Fishing	Other	Fugitive fuel emissions
	1	1A	1A1	1A2	1A3	2A4	1.A.4a	1.A.4b	1.A.4c	1.A.5	1B
						CO_2					
1988	90726	90726	43217	24755	13814	8940	1068	6654	1219	NO	NA, NE
1989	90789	90789	43690	25215	13245	8639	773	6609	1256	NO	NA, NE
1990	78673	78673	39601	21821	10864	5381	172	4787	422	1006	NA, NE
1991	63357	63357	37106	14758	6525	4086	124	3633	330	882	NA, NE
1992	57197	57197	33862	12093	6435	4610	107	4354	149	196	NA, NE
1993	59682	59682	34092	13296	7444	4117	114	3890	114	733	NA, NE
1994	56658	56658	30945	15032	6547	3325	96	2962	267	810	NA, NE
1995	59376	59376	31572	18023	6845	2621	64	2456	102	315	NA, NE
1996	58208	58208	30652	17499	6559	3238	114	3095	28	261	NA, NE
1997	56703	56703	30936	17691	5285	2678	46	2632	NO	112	NA, NE
1998	51235	51235	27502	14217	6478	2989	288	2544	157	49	NA, NE
1999	46750	46750	25760	12283	6215	2491	503	1795	194	NO	NA, NE
2000	45869	45869	26216	11868	5889	1896	330	1362	204	NO	NA, NE
2001	47486	47486	29036	10788	6024	1638	574	884	180	NO	NA, NE
2002	45066	45066	26466	10198	6329	2074	388	1511	174	NO	NA, NE
2003	49180	49180	28330	11533	7111	2206	287	1741	178	NO	NA, NE
2004	48289	48289	28298	10818	7415	1758	200	1354	204	NO	NA, NE
2005	48921	48921	28685	10421	8115	1700	224	1241	235	NO	NA, NE

2006	49823	49823	29041	10264	8622	1897	383	1295	219	NO	NA, NE
CH_4											
1988	163.5	7.72	0.84	0.57	2.98	1.66	0.32	1.23	0.10	1.67	155.7
1989	165.3	7.98	0.81	0.58	3.08	1.61	0.29	1.22	0.10	1.91	157.3
1990	112.1	6.92	0.91	0.35	2.91	1.11	0.08	0.95	0.09	1.64	105.2
1991	97.8	5.13	0.74	0.31	1.41	0.83	0.06	0.71	0.06	1.83	92.7
1992	100.8	5.20	0.66	0.25	1.70	1.01	0.07	0.88	0.07	1.58	95.6
1993	101.0	5.17	0.59	0.27	1.93	0.87	0.05	0.81	0.01	1.52	95.9
1994	99.1	5.31	0.53	0.28	1.88	1.02	0.05	0.93	0.04	1.61	93.8
1995	106.1	5.83	0.56	0.34	2.02	1.33	0.05	1.27	0.01	1.58	100.3
1996	104.5	5.74	0.52	0.32	1.70	1.58	0.03	1.55	0.00	1.61	98.8
1997	93.8	5.41	0.52	0.30	1.26	1.62	0.03	1.58	NO	1.72	88.4
1998	96.1	7.27	0.45	0.30	1.43	3.55	0.39	3.14	0.01	1.54	88.9
1999	84.4	7.25	0.43	0.28	1.51	3.48	0.23	3.15	0.10	1.55	77.1
2000	93.6	8.19	0.43	0.23	1.42	4.71	0.16	4.42	0.13	1.41	85.4
2001	91.5	7.78	0.47	0.22	1.27	4.44	0.14	4.28	0.02	1.37	83.7
2002	91.0	8.90	0.43	0.21	1.39	5.30	0.13	5.15	0.02	1.57	82.2
2003	90.7	8.97	0.45	0.24	1.44	5.58	0.21	5.34	0.03	1.26	81.8
2004	94.8	9.35	0.45	0.23	1.29	5.75	0.14	5.57	0.03	1.63	85.5
2005	91.7	9.08	0.45	0.21	1.42	5.54	0.22	5.28	0.05	1.46	82.6
2006	94.9	9.51	0.45	0.23	1.54	5.91	0.29	5.59	0.03	1.37	85.4
N_2O											
1988	1.64	1.64	0.97	0.14	0.33	0.16	0.018	0.13	0.012	0.03	NA, NE
1989	1.62	1.62	1.00	0.13	0.31	0.15	0.014	0.13	0.012	0.04	NA, NE
1990	1.41	1.41	0.80	0.21	0.25	0.10	0.003	0.09	0.006	0.04	NA, NE
1991	1.16	1.16	0.79	0.09	0.15	0.07	0.002	0.07	0.004	0.05	NA, NE
1992	1.16	1.16	0.82	0.08	0.14	0.08	0.002	0.08	0.003	0.04	NA, NE
1993	1.16	1.16	0.80	0.08	0.17	0.07	0.002	0.07	0.001	0.04	NA, NE
1994	1.13	1.13	0.79	0.10	0.14	0.06	0.002	0.06	0.003	0.04	NA, NE
1995	1.20	1.20	0.84	0.11	0.14	0.06	0.002	0.06	0.001	0.04	NA, NE
1996	1.19	1.19	0.83	0.11	0.14	0.08	0.003	0.07	0.000	0.04	NA, NE
1997	1.20	1.20	0.85	0.13	0.12	0.07	0.001	0.07	NO	0.04	NA, NE
1998	1.17	1.17	0.80	0.09	0.13	0.11	0.007	0.10	0.002	0.03	NA, NE
1999	1.07	1.07	0.73	0.07	0.13	0.10	0.008	0.09	0.004	0.03	NA, NE
2000	1.10	1.10	0.76	0.07	0.13	0.12	0.005	0.11	0.005	0.03	NA, NE
2001	1.18	1.18	0.83	0.07	0.14	0.11	0.007	0.10	0.002	0.03	NA, NE
2002	1.13	1.13	0.75	0.07	0.15	0.13	0.006	0.13	0.003	0.03	NA, NE
2003	1.24	1.24	0.82	0.08	0.17	0.14	0.006	0.13	0.003	0.03	NA, NE
2004	1.23	1.23	0.81	0.07	0.18	0.14	0.005	0.13	0.003	0.03	NA, NE
2005	1.23	1.23	0.80	0.06	0.20	0.13	0.006	0.12	0.004	0.03	NA, NE
2006	1.25	1.25	0.81	0.06	0.21	0.14	0.009	0.13	0.003	0.03	NA, NE

3.2.1. Energy Industries

Description of Source Categories

Sub-sector Energy Industries included the groups:

• Public Electricity and Heat Production;

• Petroleum Refining;

• Solid fuels Production and Other Energy Industries.

The aggregation level for sub-sector Energy Industries was the fuel type and the power plant type – only for electricity production, co-generation and for heat production. Based on data, specific for the country, as well as data from IPCC Guidance, summary emission factors were determined for the main GHG - CO_2, CH_4 and N_2O, for the GHG-precursors - CO, NOx and NMVOC, and for the SOx. At the end of 2002, desulphurization facilities in TPP MARITZA IZTOK 2 started to operate, thus reducing the SOx emissions. **Table 3.5** shows the GHG emissions from sub-sector Energy Industries.

The stationary combustion processes in the Energy Industries (power engineering, petroleum refineries, solid fuels production and other energy industries) with **coal** were the largest GHG emission source in Bulgaria. This source emitted 25 530 Gg of CO2 in 2006, which represented 36% of the total GHG emissions, expressed in CO2-eq.

Methodology

This emission source included the main power facilities in Bulgaria, combusting domestic low caloric lignite, with high sulphur and ash content. CO_2 emissions were estimated by a method of the type Tier 2, using the data from the energy balance of the country. National emission factors were used for the main GHGs, obtained by measurement and analytical calculations for power plants in the complex MARITZA IZTOK, where domestic lignite is combusted. These emission factors are aggregated to fuel type and power plant type – electricity power plants, co-generation plants, auto-generator plants and heat plants. Using a method of the type Tier 2 meets the requirements of Good Practice Guidance because this source is included in the key source list – see **Table 3.2**.

The CO_2 emissions in 2006 are the same as in 2003. It was due to a stable structure of the power units after stopping of the two units in NPP Kozloduy, increased energy efficiency in industry and household and due to energy market conditions in the region. Indicator for that was the fact that the gross electricity consumption in the country increased by 7.7%, and the export went up by 31% - **Table 3.6.**

Table 3.5. GHG emissions from the Energy Industries, Gg

Gas/Sub-sources	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
CO_2										
1A1a.Public Electricity and Heat Production	43216,90	43689,95	37939,36	35823,31	32881,79	32969,43	29830,20	30350,15	29470,32	29928,82
1A1b.Petroleum Refining	NO	NO	355,90	362,04	58,44	59,06	47,93	50,66	50,63	50,67
1A1c.Manufacture of Solid Fuels and Other Energy Industries	NO	NO	1305,97	920,87	922,16	1063,10	1066,60	1171,14	1130,67	956,59
CH_4										
1A1a.Public Electricity and Heat Production	0,84	0,81	0,87	0,71	0,63	0,56	0,50	0,53	0,49	0,49
1A1b.Petroleum Refining	NO	NO	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00
1A1c.Manufacture of Solid Fuels and Other Energy Industries	NO	NO	0,04	0,03	0,03	0,03	0,03	0,03	0,04	0,03
N_2O										
1A1a.Public Electricity and Heat Production	0,97	1,00	0,80	0,79	0,81	0,80	0,79	0,83	0,82	0,85
1A1b.Petroleum Refining	NO	NO	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1A1c.Manufacture of Solid Fuels and Other Energy Industries	NO	NO	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Gas/Sub-sources	1998	1999	2000	2001	2002	2003	2004	2005	2006
CO_2									
1A1a.Public Electricity and Heat Production	26457,74	24498,73	24881,39	27805,16	25200,66	27264,06	27043,49	27262,52	27425,26
1A1b.Petroleum Refining	NO	141,81	48,06	51,52	48,40	42,14	52,53	48,73	50,63
1A1c.Manufacture of Solid Fuels and Other Energy Industries	1044,24	1119,79	1286,30	1179,22	1216,51	1023,66	1201,60	1373.49	1564.79
CH_4									
1A1a.Public Electricity and Heat Production	0,42	0,39	0,39	0,43	0,39	0,42	0,41	0,41	0,41
1A1b.Petroleum Refining	NO	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1A1c.Manufacture of Solid Fuels and Other Energy Industries	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.04
N_2O									
1A1a.Public Electricity and Heat Production	0,80	0,72	0,75	0,83	0,74	0,82	0,81	0,79	0,80
1A1b.Petroleum Refining	NO	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
1A1c.Manufacture of Solid Fuels and Other Energy Industries	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table 3.6. Gross production, import, export and gross consumption of electricity, millions kWh

Year	Fossil fuel, non CHP	Nuclear	CHP and other	Hydro	Gross Production	Import	Export	Gross domestic use
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
1988	19 973	16 030	6 422	2 596	**45 021**	4 450	304	**49 167**
1989	20 700	14 565	6 371	2 691	**44 328**	4 937	548	**48 716**
1990	19 899	14 665	5 705	1 852	**42 121**	5 387	1 597	**45 911**
1991	17 898	13 184	5 311	2 441	**38 834**	3 083	959	**40 958**
1992	17 271	11 552	4 660	2 063	**35 546**	3 289	584	**38 252**
1993	17 303	13 896	4 760	1 941	**37 901**	1 634	1 518	**38 017**
1994	16 762	15 334	4 713	1 509	**38 318**	1 173	1 245	**38 246**
1995	17 675	17 261	4 558	2 506	**42 001**	1 961	2 121	**41 841**
1996	17 060	18 082	4 676	2 984	**42 801**	1 803	2 252	**42 352**
1997	17 457	17 751	4 692	2 928	**42 828**	785	4 335	**39 278**
1998	16 964	16 899	4 533	3 315	**41 711**	564	4 211	**38 064**
1999	15 115	15 814	4 357	2 979	**38 265**	1 670	3 627	**36 309**
2000	15 781	18 178	4 010	2 958	**40 927**	964	5 584	**36 307**
2001	18 468	19 553	3 781	2 166	**43 968**	1 092	8 017	**37 043**
2002	15 960	20 222	3 810	2 741	**42 732**	2 040	8 335	**36 437**
2003	17 624	17 278	4 350	3 294	**42 546**	1 283	6 772	**37 057**
2004	15 517	16 815	5 925	3 363	**41 620**	742	6 620	**35 742**
2005	14 876	18 653	3 818	4 761	**44 249**	799	8 380	**36 668**
2006	15 819	19 493	3 736	4 620	**45 807**	1 139	8 882	**38 064**

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 9%.

The analysis of time series indicated a permanent reduction trend until 1998. In the next period emission increase started mainly due to the increased export and stopping of the two 440 MW units in NPP Kozloduy. Export increase revealed a great dynamics. In 1997 it doubled, compared to the preceding years. In 2001 export doubled again, thus reaching in natural units up to 8 335 GWh in 2002. After some decrease by about 20 % in 2003 and 2004, in the end of 2006 the level of 2002 is achieved again.

The fuels used by this emission source, taken from the energy balance, are aggregated by physical condition – solid, liquid and gaseous, for the purposes of the CRF Tables. Besides, the secondary gases, coke-oven gas and blast furnace gas, are added to the solid fuels, and dry gas from oil refining and petroleum coke was added to the liquid fuels.

3.2.2. Manufacturing Industries and Construction

Description of Source Categories

Sub-sector Manufacturing Industries and Construction included the groups:

- Ferrous metallurgy;
- Non-ferrous metallurgy;
- Chemical industry;
- Pulp and Paper production and printing industry;
- Food industry;
- Other.

The group Other included machinery construction, electrical engineering, light industry and auto-generating plants for combined production of electrical and thermal energy.

The aggregation level of sub-sector Manufacturing industries and construction was mainly the fuel type, as in some cases the type of combustion technology was reported as well. **Table 3.7** shows basic GHG emissions in the sub-sector categories.

Table 3.7. Emissions from Manufacturing Industries and Construction (1A2), Gg

Gas/ Sub-sources	Iron and Steel	Non-ferrous metals	Chemicals	Pulp, Paper and Print	Food Processing, Beverage and Tobacco	Other
	1A2.a	1A2.b	1A2.c	1A2.d	1A2.e	1A2.f
			CO_2			
1988	5171	637	4049	196	613	14089
1989	5308	682	4019	128	617	14461
1990	3448	366	3487	61	228	14231
1991	3080	275	2844	121	154	8284
1992	2757	243	2115	72	219	6688
1993	3163	324	2125	24	131	7528
1994	4318	336	2337	29	87	7926
1995	5198	366	3237	33	88	9102
1996	4675	388	3210	30	53	9143
1997	5079	344	2741	8	69	9450
1998	3420	420	2079	274	676	7348
1999	2420	447	1781	201	674	6760
2000	3332	399	3129	191	642	4175
2001	3057	362	2748	138	548	3935
2002	2843	293	2145	362	526	4029
2003	3486	277	1980	280	485	5025
2004	3028	332	2369	221	474	4393
2005	2817	317	2254	220	422	4391
2006	2662	323	2266	193	498	4322
			CH_4			
1988	0,05	0,015	0,07	0,005	0,020	0,41
1989	0,06	0,015	0,06	0,004	0,019	0,42
1990	0,04	0,006	0,05	0,008	0,008	0,25
1991	0,03	0,004	0,03	0,006	0,005	0,23
1992	0,02	0,003	0,02	0,005	0,008	0,19
1993	0,02	0,005	0,03	0,002	0,005	0,21
1994	0,03	0,005	0,03	0,002	0,003	0,21
1995	0,03	0,005	0,04	0,003	0,003	0,25
1996	0,03	0,004	0,04	0,001	0,002	0,25
1997	0,03	0,004	0,03	0,000	0,003	0,23
1998	0,04	0,007	0,02	0,009	0,028	0,20
1999	0,03	0,008	0,02	0,008	0,026	0,19
2000	0,03	0,006	0,05	0,011	0,026	0,11
2001	0,03	0,007	0,06	0,004	0,021	0,10
2002	0,03	0,006	0,05	0,012	0,020	0,09
2003	0,03	0,005	0,06	0,008	0,018	0,11
2004	0,03	0,004	0,07	0,007	0,018	0,11
2005	0,03	0,006	0,06	0,007	0,012	0,09
2006	0,03	0,006	0,07	0,006	0,015	0,10
			N_2O			
1988	0,037	0,006	0,013	0,003	0,005	0,080
1989	0,038	0,007	0,014	0,002	0,006	0,063
1990	0,024	0,004	0,011	0,001	0,002	0,170
1991	0,019	0,003	0,008	0,001	0,001	0,062
1992	0,017	0,003	0,005	0,001	0,002	0,049
1993	0,023	0,004	0,004	0,000	0,001	0,051
1994	0,031	0,004	0,006	0,000	0,001	0,056
1995	0,040	0,004	0,008	0,000	0,001	0,061
1996	0,035	0,004	0,008	0,000	0,000	0,063
1997	0,037	0,004	0,007	0,000	0,001	0,077
1998	0,017	0,004	0,006	0,001	0,006	0,058
1999	0,009	0,005	0,009	0,001	0,006	0,045
2000	0,013	0,004	0,014	0,001	0,006	0,027
2001	0,015	0,004	0,016	0,001	0,004	0,027
2002	0,014	0,003	0,013	0,004	0,004	0,030
2003	0,017	0,003	0,010	0,002	0,004	0,041
2004	0,015	0,004	0,016	0,001	0,004	0,033

2005	0,013	0,003	0,013	0,001	0,003	0,031
2006	0,011	0,003	0,017	0,001	0,003	0,030

CO_2 emissions from coal combustion in this sub-sector were a key source, ranked at fourth place in key source list, and were responsible for 5.62 % of the total GHG emissions of Bulgaria in 2006.

The biggest share in these emissions had the other industries (machinery construction, electrical engineering, factory plants, etc.), ferrous metallurgy and the chemistry. These industry branches topped 90% of the emissions in the sub-sector – see **Table 3.8.**

CO_2 emissions of non-energy fuel use are added to this sub-sector as well.

The key source list included also two sources - CO_2 emissions from stationary combustion of liquid and gaseous fuels. In these key sources were included mainly the categories of this sub-sector and sub-sector Public Electricity and Heat Production.

Methodology

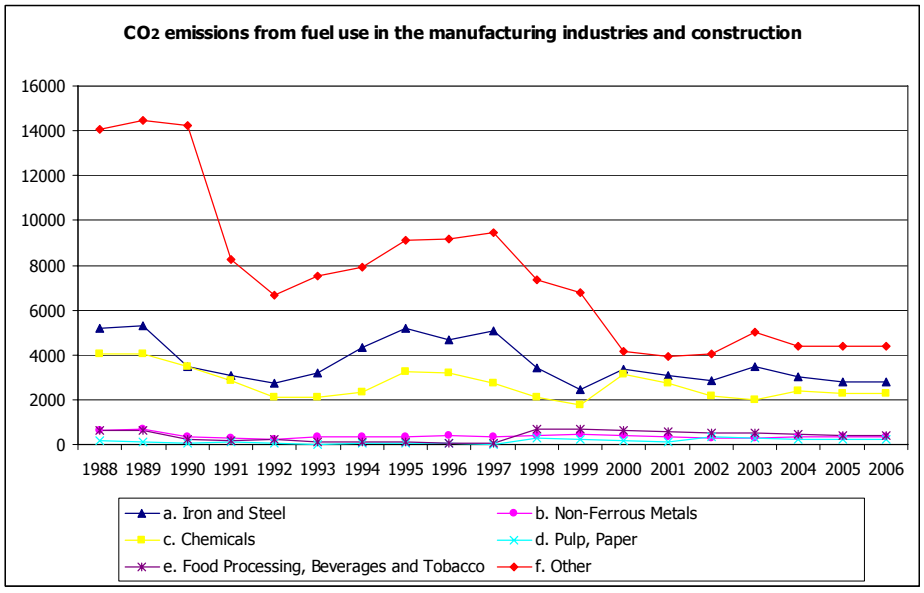
This emission source included the main power facilities in Bulgaria industry, combusting all basic types of fuels. CO_2 emissions are estimated by a method of the type Tier 2, using the data from the energy balance of the country, prepared by NSI. National emission factors are mainly used for the basic GHGs, as well as standard IPCC factors. Method of the type Tier 1 is applied for emissions from non-energy use of fuels. This method corresponds to the good practice only for non-energy emissions of solid and liquid fuels, which were not key sources – see **Table 3.2**.

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 7 - 9%.

The CO_2 emissions trends are shown on **Figure 3.1.**

Figure 3.1



The analysis of time series indicated a permanent reduction trend, with two minimums – in 1992 and in 2000. These two minimums reflected the economy crisis, related to the transition to market mechanisms of functioning and management, closing down a number of undertakings, and the change of the international markets of the country. Significant contribution to the emission reduction had the programs and measures for energy efficiency, as well as the technological renovation of branches such as food industry, machinery and electricity engineering, construction and others. There was a growth in the last four years, biggest in 2003, as it reflected surmounting of the crisis.

Table 3.9 shows the CO_2 emissions by basic types of fuels in the sub-sector.

Table 3.8. CO_2 emissions from fuel use in the Manufacturing Industries and Construction, Gg

Gas/subsource	1A2a. Iron and Steel	Feedstock	1A2b. Non-Ferrous Metals	1A2.c Chemicals	fuel combustion (Tier 1)	feedstock	1A2d. Pulp, Paper and Print	1A2e. Food Processing, Beverages and Tobacco	1A2f. Other	Total
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
1988	5171	80	637	4049	2704	1344	196	613	14089	**24755**
1989	5308	81	682	4019	2736	1282	128	617	14461	**25215**
1990	3448	72	366	3487	2262	1225	61	228	14231	**21821**
1991	3080	37	275	2844	1498	1346	121	154	8284	**14758**
1992	2757	48	243	2115	979	1135	72	219	6688	**12093**
1993	3163	64	324	2125	1099	1027	24	131	7528	**13296**
1994	4318	74	336	2337	1354	983	29	87	7926	**15032**
1995	5198	78	366	3237	1938	1299	33	88	9102	**18023**
1996	4675	74	388	3210	1774	1436	30	53	9143	**17499**
1997	5079	82	344	2741	1482	1259	8	69	9450	**17691**
1998	3420	47	420	2079	1109	969	274	676	7348	**14217**
1999	2420	54	447	1781	882	899	201	674	6760	**12283**
2000	3332	71	399	3129	1849	1280	191	642	4175	**11868**
2001	3057	52	362	2748	1765	984	138	548	3935	**10788**
2002	2843	45	293	2145	1453	692	362	526	4029	**10198**
2003	3486	53	277	1980	1249	730	280	485	5025	**11533**
2004	3028	51	332	2369	1517	852	221	474	4393	**10818**
2005	2817	46	317	2254	1355	899	220	422	4391	**10421**
2006	2662	37	323	2265	1431	637	193	498	4322	**10264**

Table 3.9 CO_2 emissions by main fuels type in the Manufacturing Industries and Construction, Gg

Gas/sub-source	Liquid Fuels	Solid Fuels	Gaseous Fuels	Biomass	Other Fuels	Total
	Gg	Gg	Gg	Gg	Gg	Gg
1988	7 740	9 353	7 661	55	NO	24 809
1989	7 939	9 697	7 580	52	NO	25 268
1990	2 075	14 277	5 469	56	NO	21 877
1991	3 596	6 087	5 074	37	NO	14 794
1992	2 577	5 066	4 451	43	NO	12 136
1993	2 280	6 083	4 933	22	NO	13 318

1994	2 350	7 542	5 139	25	NO	15 058
1995	3 326	8 627	6 070	27	NO	18 050
1996	3 015	8 469	6 015	23	NO	17 522
1997	3 424	9 832	4 435	17	NO	17 709
1998	4 540	5 719	3 959	95	NO	14 312
1999	4 107	5 242	2 934	100	NO	12 383
2000	3 415	5 033	3 420	118	NO	11 987
2001	3 008	4 863	2 917	177	NO	10 965
2002	3 240	4 504	2 455	192	NO	10 390
2003	3 495	5 398	2 641	242	NO	11 775
2004	3 219	4 905	2 693	260	NO	11 077
2005	2 944	4 395	3 082	190	NO	10 611
2006	2 986	4 010	3 268	193	NO	10 264

The analysis of the table above indicated that solid fuels had the majority in the base year, and this has been kept during the whole inventory period. Reduction of overall emission level in 2006 is more than two times compared to the base year.

Table 3.10 shows CO_2 emissions of non-energy use of fuels. These emissions are reported by applying the Reference Approach, as well as for the Sectoral approach (start from NIR 2005).

Table 3.10 Trends in CO_2 emissions by feedstock use of energy carriers according to the IPCC Reference Approach, Gg

Years/Fuels	Liquid Fuels	Solid Fuels	Gaseous Fuels	Total
1988	354	80	11 401	**11 835**
1989	297	81	11 729	**12 107**
1990	206	72	12 085	**12 363**
1991	105	37	10 158	**10 300**
1992	102	48	8 978	**9 128**
1993	123	64	8 435	**8 622**
1994	100	74	8 493	**8 667**
1995	454	78	10 293	**10 825**
1996	452	74	10 440	**10 966**
1997	415	82	8 225	**8 722**
1998	438	47	7 436	**7 921**
1999	330	54	5 978	**6 362**
2000	336	71	6 358	**6 765**
2001	50	52	5 905	**6 007**
2002	60	45	5 271	**5 376**
2003	74	53	5 475	**5 602**
2004	76	51	5 444	**5 571**
2005	68	46	6 178	**6 292**
2006	65	37	6 494	**6 531**

Emission trend from **non-energy** use of fuels indicated significant reduction until 2003 and after that, there is an increase again at the cost of the non-energy use of the natural gas. The cause is the observed stir in the production of nitrous fertilizers.

3.2.3. Transport

Description of Source Categories

Sub-sector Transport included the groups air, sea, road, inland waterway transport and other kinds of transport. The group Other transport included emission sources form agriculture and construction, such as agriculture machinery for land cultivation, wood processing machinery, construction machinery, etc. The last are so-called off-road machines. This type of machines is basically user of diesel fuel. Only a small part of them (tree cutters, mowers and others) uses gasoline or motor gasoline.

The aggregation level was by fuel type, vehicle type and dimensions (the engine volume for cars and the loading capacity for trucks). In this case the emission factors are expressed in natural units, i.e. g/kg of fuel. It did not concern LPG, for which the emission factor is expressed in energy units GJ.

Table 3.11 shows the GHG emission trends from mobile sources for the period 1988-2006.

Table 3.11. Trends of greenhouse gas emissions from Transport sub sector, Gg

Gas/ Sub-sources	Civil Aviation	Road Transportation	Railways	Navigation	Other Transportation	Total
	1A2.a	1A2.b	1A2.c	1A2.d	1A2.e	1A2
			CO_2			
1988	612	7747	368	1088	3998	**13814**
1989	354	8060	347	1162	3322	**13245**
1990	317	7586	334	58	2569	**10864**
1991	270	4418	223	4	1610	**6525**
1992	315	4646	175	7	1293	**6435**
1993	315	5751	178	9	1192	**7444**
1994	317	4976	132	12	1109	**6547**
1995	276	5390	114	13	1053	**6845**
1996	214	5306	121	30	888	**6559**
1997	183	4016	1	5	1079	**5285**
1998	120	5154	131	10	1064	**6478**
1999	35	5327	120	8	724	**6215**
2000	32	5016	122	NO, NA	720	**5889**
2001	46	5197	106	NO, NA	675	**6024**
2002	48	5496	97	NO, NA	688	**6329**
2003	56	6281	89	NO, NA	685	**7111**
2004	104	6562	89	NO, NA	659	**7415**
2005	120	7178	94	NO, NA	724	**8115**
2006	122	7618	93	NO, NA	788	**8622**
			CH_4			
1988	0.06	2.55	0.03	0.083	0.26	**2.97**
1989	0.03	2.68	0.03	0.089	0.25	**3.07**
1990	0.01	2.59	0.03	0.004	0.28	**2.90**
1991	0.01	1.21	0.02	0.000	0.18	**1.41**
1992	0.01	1.54	0.01	0.000	0.14	**1.70**
1993	0.01	1.78	0.01	0.001	0.13	**1.93**
1994	0.01	1.73	0.01	0.001	0.13	**1.87**
1995	0.01	1.89	0.01	0.001	0.12	**2.02**
1996	0.01	1.59	0.01	0.002	0.10	**1.70**
1997	0.01	1.13	0.00	0.000	0.12	**1.26**
1998	0.00	1.30	0.01	0.001	0.12	**1.43**
1999	0.00	1.40	0.01	0.001	0.10	**1.51**
2000	0.00	1.31	0.01	NO, NA	0.10	**1.42**
2001	0.00	1.17	0.01	NO, NA	0.09	**1.27**
2002	0.00	1.29	0.01	NO, NA	0.09	**1.39**

2003	0.00	1.34	0.01	NO, NA	0.09	**1.44**
2004	0.01	1.20	0.01	NO, NA	0.09	**1.29**
2005	0.00	1.31	0.01	NO, NA	0.09	**1.42**
2006	0.00	1.43	0.01	NO, NA	0.10	**1.54**
N_2O						
1988	0.00070	0.16	0.009	0.0273	0.13	**0.33**
1989	0.00037	0.16	0.009	0.0292	0.11	**0.31**
1990	0.00004	0.15	0.008	0.0015	0.09	**0.25**
1991	0.00003	0.09	0.006	0.0001	0.06	**0.15**
1992	0.00001	0.09	0.004	0.0002	0.05	**0.14**
1993	0.00001	0.12	0.004	0.0002	0.04	**0.17**
1994	0.00003	0.10	0.003	0.0003	0.04	**0.14**
1995	0.00002	0.10	0.003	0.0003	0.04	**0.14**
1996	0.00001	0.11	0.003	0.0008	0.03	**0.14**
1997	0.00001	0.08	0.000	0.0001	0.03	**0.12**
1998	0.00002	0.10	0.003	0.0002	0.03	**0.13**
1999	0.00000	0.11	0.003	0.0002	0.02	**0.13**
2000	0.00002	0.11	0.003	NO, NA	0.02	**0.13**
2001	0.00003	0.12	0.003	NO, NA	0.02	**0.14**
2002	0.00004	0.13	0.002	NO, NA	0.02	**0.15**
2003	0.00003	0.15	0.002	NO, NA	0.02	**0.17**
2004	0.00003	0.16	0.002	NO, NA	0.02	**0.18**
2005	0.00002	0.18	0.002	NO, NA	0.02	**0.20**
2006	0.00001	0.19	0.002	NO, NA	0.02	**0.21**

CO_2 emissions from **road transport** were key source of GHG emissions. These emissions were 6% of the overall country emissions in 2006. Another key source was the CO_2 emissions from **other transport**, with 1% share in the overall emissions.

The road transport was the largest emission source of main GHGs in sub-sector Transport - 88% of the CO_2 emissions, 93% of methane emissions, and 90 % of N_2O emissions.

CO_2 emissions from the other kinds of transport were significantly less (about two times), compared to the road transport. Off-road emissions were about one time less than the road transport.

The air transport emissions were spitted between domestic and international transport based on expert assessment. The overall quantities of the used kerosene used were indicated in the energy balance of the country. It was assumed that 80% of kerosene was used for international transport and the relevant emissions were reported in international bunkering.

Table 3.12 shows GHG-precursors emissions with the higher values in this sub-sector – for CO and NMVOC from the corresponding overall emissions of the country, and on second place for NOx, following the Energy sector.

The main GHG emissions from the source increased by 5.2% in 2006 compared to the preceding year. This was due to increased diesel fuel consumption in the road transport.

Table 3.13 shows the trend of fuel quantities, used by the road transport. It shows a stable growth after 1997.

Table 3.12. GHG-precursors emissions from Mobile sources, Gg

Year/GHG-precursors	NOx	CO	NMVOC	SO2
	Gg	Gg	Gg	Gg
1988	115.56	454.37	67.08	57.85
1989	114.61	468.72	70.18	49.32
1990	97.80	434.83	66.25	17.99

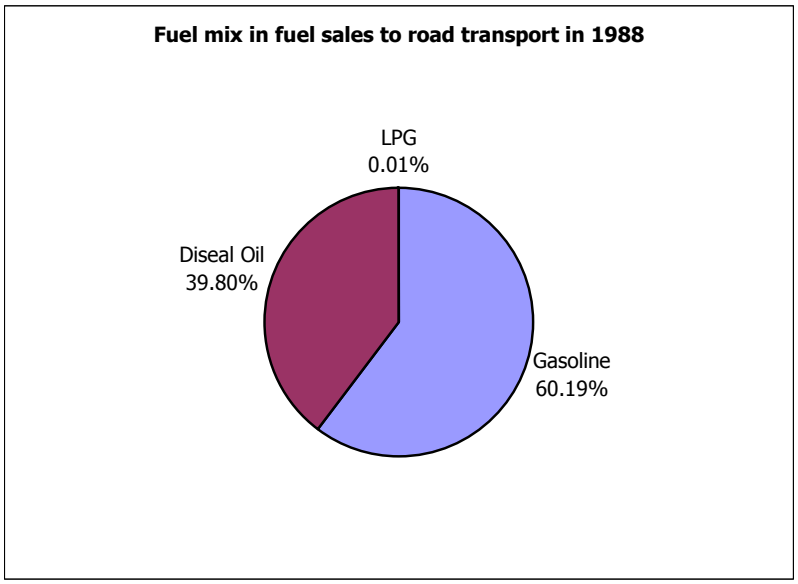
1991	57.59	215.97	34.24	10.53
1992	51.75	260.37	39.11	9.59
1993	56.03	303.98	45.88	11.02
1994	48.86	296.86	44.01	9.07
1995	49.38	327.58	48.22	8.82
1996	45.29	267.54	40.57	9.44
1997	41.77	189.96	29.90	7.80
1998	48.44	241.04	39.29	8.35
1999	45.23	239.01	38.53	8.00
2000	47.29	221.28	36.37	7.09
2001	48.06	202.20	34.57	7.30
2002	51.47	220.02	37.42	7.47
2003	56.19	221.69	38.46	8.78
2004	50.59	205.46	36.89	9.52
2005	60.54	218.44	38.04	10.54
2006	64.47	231.95	40.42	11.21

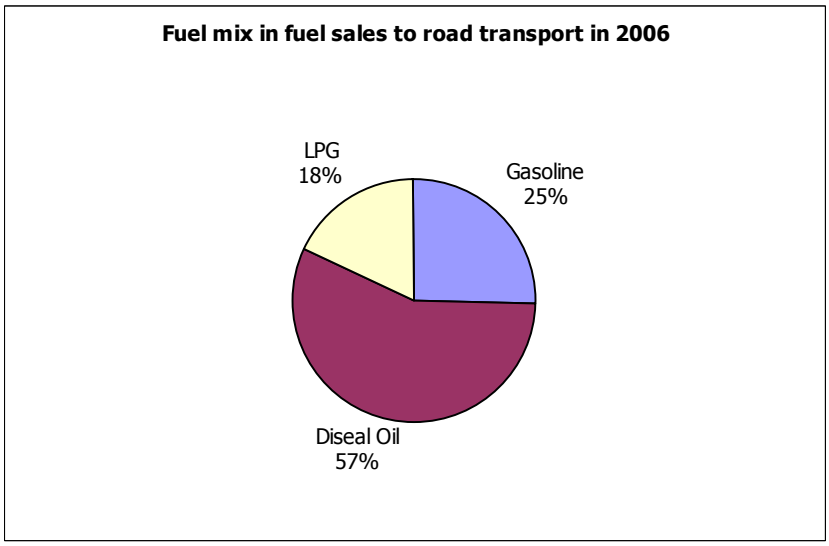
Table 3.13. Fuels for Road Transportation, TJ

Year/Fuel Consumption	Gasoline TJ	Diseal Oil TJ	LPG TJ	Total TJ
1988	63234.834	41816.95	11.544	**105063.3**
1989	67409.316	41966.38	9.464	**109385.2**
1990	61642.65	42454.69	0.89889	**104098.2**
1991	28955.226	30958.98	1.2	**59915.41**
1992	36908.346	27490.46	0.14	**64398.94**
1993	43176.09	35914.37	1.7	**79092.16**
1994	43571.853	26138.43	5.6	**69715.89**
1995	48049.613	26838.95	4.4	**74892.96**
1996	40431.418	33190.78	15	**73637.2**
1997	26780.212	27336.71	27.6	**54144.53**
1998	35168	31821.2	3057	**70046.2**
1999	34563.821	33760.66	4156.35	**72480.83**
2000	29018.61	30204.19	9842.25	**69065.05**
2001	24928.276	33793.81	13061	**71783.09**
2002	26795.46	34295.91	15045.55	**76136.92**
2003	25761.629	44112.39	16825	**86699.01**
2004	24553.57	50005.73	15558	**90117.3**
2005	23920.369	56580.2	18096.65	**98597.23**
2006	26603.493	59155.53	18905.77	**104664.8**

Figure 3.2 shows the change in the fuel sales in 2006, compared to the base 1988. A clear trend towards increase of fuel sales can be seen, concerning the fuels that emit less air pollutants, including GHG. Obviously, the LPG consumption trend is remarkable. The volume of consumed LPG in road transportation is over the 18% from total fuel road consumption in 2006.

Figure 3.2





The fuel sales, shown on **Figure 3.2** and **Table 3.13 and GHG emissions in Table 3.11** should be estimated on the basis of more than a double increase of number of automobiles (cars, trucks, buses) in 2006, compared to the base year.

Methodology

The CO_2 emissions are calculated according to the reported fuel consumption in the Energy Balance. The consumed fuels are apportioned for different vehicle types - cars, buses and trucks. A methodology is applied which helps to distribute; considering the number of vehicles, engine volume, loading capacity and the mileage. Data for the number of vehicles is provided by the Road Control Department within the Ministry of Interior (MOI).

The emissions are estimated after a method of the type Tier 2, with emission factors depending on the engine volume, loading capacity and the fuel type. The emission

factors were based on measurements and studies of the motor fleet in the country. The characteristic features of these fleet vehicles have not changed significantly since the last GHG inventory, 2005. The indices retained nearly the same: high average age of the cars, (40 % from the cars are over 20 years old and only 10 % below 10 years), big share of old cars (Lada, Moskvich, Trabant, etc.), significant number of the imported second-hand cars (over 150 000 ones in the current year), relatively not a big share of the imported new cars. Nevertheless, a trend towards increase of the quantity of new cars was outlined which is deepening in the current year. In 2006 more new cars are imported which means a rise of nearly 30% compared to 2005. There was also a growth of second-hand car sales.

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 6-7% for CO_2 emissions and 100% for methane and N_2O emissions.

The CO_2 emission trends in transport formed uniform time series because for the whole period after the base 1988, there have been no changes in the methodology of calculation and collection of data for types of vehicles.

3.2.4. Other Sectors

Description of Source Categories

Sub-sector Other sectors include the groups:

- Commercial/institutional and services;
- Households;
- Agriculture and forestry.

These groups include only stationary sources, as the aggregation level was the type of the fuel and the combustion technology in the corresponding group (services, households, agriculture). The emission factors applied were combination of those standard values, recommended by the IPCC Guidance, and results from measurements and analytical studies, factors specific for the country.

Table 3.14 shows the main GHG emissions in the sub-sector.

The analysis of **Table 3.14** showed that the category **households** had a predominating role. More than 71% of CO_2 emissions, 95% of methane emissions and 91% of N_2O emissions were emitted from this category.

The CO_2 emissions from stationary combustion processes – **other sectors, coal,** were key GHG emission source. This source ranked 13 place in key source list (estimated by method Tier 1 – with emission level assessment) and produced 2% of the overall emissions of the country in 2006.

The consumption of fuels in the sub-sector **Households** was purposed on heat and hot water production, and cooking. These activities allow using of broad range of energy carriers and technologies, and due to that, they have a great potential for reduction of GHG emissions. A Bulgarian practice was a good example for that, showing a significant consumption of wood and wood waste in the households.

The CO_2 emissions form wood and wood waste combustion in 2006 were 2 393 Gg, which shows increase by 5.9% compared to the previous year. It breaks the trend of growth in the last ten years.

Methodology

The GHG emissions are calculated according to the reported fuel consumption in the Energy Balance. A method of the type Tier 2 is applied, with emission factors, estimated after IPCC and local measurements and analytical calculations as well.

Uncertainty and Consistency of Time Series

The uncertainty of this source category was 9% for CO_2 emissions and 50% for methane and N_2O emissions.

The CO_2 emission trends in the sector formed uniform time series because for the whole period after the base 1988, there have been no changes in the methodology of calculation and collection of data. It should be noticed that the impact of the seasonal temperature changes was not reported evidently. It did not affect significantly the emitted gases, because the heating standards have not been observed always, especially in some public buildings (schools, social facilities), and in the households as well. One of the main reasons is the high fuels and centralized district heating prices.

3.2.5. Other

The GHG emissions from the use of biomass for obtaining power were estimated in this category. However, the quantities of wood and wood waste, given in the Energy Balance, were not reported here (see p. 3.2.4 above).

The following was considered as a power source in this category:

- dry twigs and brushwood and other kinds of woody biomass;
- vegetal residues from grain, vineyards, etc.;
- used charcoal;
- sludge combustion.

CO_2 emissions from this source in 2006 were 588 Gg.

Table 3.14 Trends of greenhouse gas emissions from Other sectors, Gg

Gas/ Sub-sources	Commercial/ Institutional	Residential	Agriculture/Forestry/ Fisheries
	1A2.a	1A2.b	1A2.c
CO_2			
1988	1067.55	6653.90	1218.80
1989	773.10	6609.10	1256.39
1990	171.97	4786.61	422.01
1991	123.78	3632.74	329.74
1992	106.55	4354.46	149.45
1993	113.77	3889.58	113.67
1994	96.25	2961.94	266.56
1995	63.74	2455.73	101.54
1996	113.97	3095.46	28.24

1997	45.94	2632.34	NO
1998	288.38	2543.92	156.54
1999	502.91	1794.56	193.96
2000	329.68	1361.91	204.49
2001	574.27	883.89	179.65
2002	388.33	1511.46	174.31
2003	286.65	1740.81	178.13
2004	199.88	1353.94	204.25
2005	224.09	1241.19	234.92
2006	382.75	1295.49	219.02
CH_4			
1988	0.32	1.23	0.10
1989	0.29	1.22	0.10
1990	0.08	0.95	0.09
1991	0.06	0.71	0.06
1992	0.07	0.88	0.07
1993	0.05	0.81	0.01
1994	0.05	0.93	0.04
1995	0.05	1.27	0.01
1996	0.03	1.55	0.00
1997	0.03	1.58	NO
1998	0.39	3.14	0.01
1999	0.23	3.15	0.10
2000	0.16	4.42	0.13
2001	0.14	4.28	0.02
2002	0.13	5.15	0.02
2003	0.21	5.34	0.03
2004	0.14	5.57	0.03
2005	0.22	5.28	0.05
2006	0.29	5.59	0.03
N_2O			
1988	0.018	0.13	0.012
1989	0.014	0.13	0.012
1990	0.003	0.09	0.006
1991	0.002	0.07	0.004
1992	0.002	0.08	0.003
1993	0.002	0.07	0.001
1994	0.002	0.06	0.003
1995	0.002	0.06	0.001
1996	0.003	0.07	0.000
1997	0.001	0.07	NO
1998	0.007	0.10	0.002
1999	0.008	0.09	0.004
2000	0.005	0.11	0.005
2001	0.007	0.10	0.002
2002	0.006	0.13	0.003
2003	0.006	0.13	0.003
2004	0.005	0.13	0.003
2005	0.006	0.12	0.004
2006	0.009	0.13	0.003

3.2.6. Comparison of the Sectoral Approach with the Reference Approach

The Reference approach (RA) is a method for estimating CO_2 combustion emissions by the help of limited input data. For this purpose the apparent consumption of fuels and the CO_2 emission factors of fuel combustion were needed. By the Reference approach were verified the results for CO_2 emissions, obtained with the Sectoral approach (SA). A detailed description of this method is given in **Annex 4**.

Table 3.15 presents the CO_2 emissions, calculated by the Reference approach, and the emissions from fuel combustion, calculated by the Sectoral approach.

Comparison of the two approaches indicated difference 2.34% for 2006.

Table 3.15. Comparison of CO_2 emissions: Reference Approach (RA) versus National Approach (NA), Gg

IPCC Sector	Reference Approach				National Approach (SA)	Difference
	Liquid Fuels	Solid Fuels	Gaseous Fuels	Total		
	Gg	Gg	Gg	Gg	Gg	%
1988	34 832	44 926	11 401	91 159	90 726	0.48
1989	34 055	44 671	11 729	90 455	90 789	-0.37
1990	28 320	40 554	12 085	80 960	78 673	2.91
1991	19 254	34 727	10 158	64 139	63 357	1.23
1992	15 300	32 758	8 978	57 036	57 197	-0.28
1993	18 317	34 722	8 435	61 474	59 682	3.00
1994	16 873	31 760	8 493	57 126	56 658	0.83
1995	16 634	32 835	10 293	59 763	59 376	0.65
1996	14 575	33 418	10 440	58 432	58 208	0.39
1997	12 068	34 897	8 225	55 190	56 703	-2.67
1998	11 412	32 541	7 436	51 389	51 235	0.30
1999	11 742	28 693	5 978	46 413	46 750	-0.72
2000	10 879	28 900	6 358	46 136	45 869	0.58
2001	10 683	31 564	5 905	48 152	47 486	1.40
2002	11 923	28 649	5 271	45 843	45 066	1.72
2003	12 198	32 151	5 475	49 825	49 180	1.31
2004	11 631	31 451	5 444	48 526	48 289	0.49
2005	13 227	30 560	6 178	49 966	49 879	0.17
2006	13 286	31 208	6 494	50 988	49 823	2.63

3.2.7. Non-energy Use of Fuels

Description of Source Categories

CO_2 emissions from non-energy use of fuels were structured in sub-sector **Manufacturing industries and construction** of Energy sector. The fuels were used as raw materials mainly in Ferrous metallurgy and Chemistry.

The portion of carbon, which is stocked in products like asphalt, plastic, fertilizers, etc., was estimated by ratios, proposed by IPCC Guidance. There are no measurements in Bulgaria for estimation of ratios, specific for the country.

Methodology

CO_2 emissions from non-energy use of fuels were estimated by the emission factors applied in the Reference approach. As a whole, the emission calculation method was of type Tier 1.

Uncertainty and consistency of time series

The uncertainty of this source category was estimated by scientific information, based on assessments of international experts, and it amounted to 6-7%.

The emission trends are shown in **Table 3.16** for the main types of fuels – liquid, solid and gaseous.

The overall emissions of Bulgaria from non-energy use of fuels in 2006 dropped down by 47.7 %, compared to the base year 1988.

Table 3.16 CO_2 emissions from non-energy use of fuels

Years/Fuels	Liquid Fuels	Solid Fuels	Gaseous Fuels	Total
1988	354	80	990	1424
1989	297	81	986	1363
1990	206	72	1019	1298
1991	105	37	1241	1383
1992	102	48	1033	1183
1993	123	64	904	1091
1994	100	74	883	1056
1995	454	78	845	1377
1996	452	74	985	1511
1997	415	82	844	1341
1998	438	47	532	1017
1999	330	54	569	953
2000	336	71	944	1351
2001	50	52	933	1036
2002	60	45	632	737
2003	74	53	656	783
2004	76	51	776	903
2005	68	46	831	945
2006	73	37	637	747

3.2.8. International Bunkers

Description of source categories

The International Bunkers include international air and sea transport.

The international transport of passengers and cargo uses fuel combustion, as GHG and pollutants in the atmosphere are emitted. These GHG emissions were also a subject of the inventory.

The GHG emissions from fuel combustion in international transport were estimated in compliance with the methods in the sector Mobile sources of Energy sector in the IPCC Guidance. The obtained GHG emission were not included in the summary emissions of the country, but reported separately in the relevant CRF tables.

In Bulgarian GHG inventories, international transport emissions were divided into two categories:

- GHG emissions from sea international transport;
- GHG emissions from air international transport.

Table 3.17 shows the fuels (in TJ) and CO_2 emissions for the period 1988-2006.

Table 3.17 International bunkers: energy consumption (TJ) and related CO_2 emissions (Gg) 1988-2006

Source	Energy consumption								CO_2 emissions							
	Marine Bunkers	Gasoline	Gas/Diesel Oil	Residual Fuel Oil	Aviation Bunkers	Jet Kerosene	Gasoline	Total	Marine Bunkers	Gasoline	Gas/Diesel Oil	Residual Fuel Oil	Aviation Bunkers	Jet Kerosene	Gasoline	Total
	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
1988	12439	NO	7659	4780	10602	10602	NO	23041	969	NO	583	385.8	749	749	NO	1718
1989	12646	NO	7292	5354	10344	10344	NO	22990	987	NO	555	432.1	731	731	NO	1719
1990	11295	1	2777	8517	12638	12377	260	23933	874	0.1	208	665.5	892	874	18	1766
1991	11430	NO	2664	8766	4536	4446	90	15966	878	NO	200	678.3	320	314	6	1198
1992	11049	NO	2725	8324	8004	7967	37	19053	873	NO	204	668.7	565	562	3	1438
1993	10589	NO	2336	8253	10464	10427	36	21053	844	NO	178	666.1	739	736	3	1583
1994	10664	NO	2240	8424	8958	8892	66	19622	850	NO	171	679.9	632	628	5	1483
1995	10684	NO	2240	8444	7782	7731	51	18466	882	NO	201	681.4	549	546	4	1432
1996	9240	NO	2240	7000	6686	6668	18	15926	732	NO	174	557.9	472	471	1	1204
1997	13624	NO	3340	10284	6056	6031	25	19680	1092	NO	262	829.9	428	426	2	1520
1998	12812	NO	2703	10109	6938	6896	42	19750	1022	NO	206	815.8	490	487	3	1512
1999	333	NO	294	39	4522	4522	NO	4855	26	NO	22.4	3.2	319	319	NO	345
2000	2696	NO	2696	NO	3822	3822	NO	6518	205	NO	205	NO	270	270	NO	475
2001	4017	NO	3975	42	5571	5571	NO	9588	306	NO	302	3.4	393	393	NO	699
2002	4416	NO	4416	NO	5654	5654	NO	10070	336	NO	336	NO	399	399	NO	735
2003	5723	NO	5723	NO	6870	6870	NO	12594	436	NO	436	NO	485	485	NO	921
2004	4813	NO	4813	NO	5741	5741	NO	10554	366	NO	366	NO	405	405	NO	772
2005	4589	NO	4589	NO	6696	6696	NO	11285	349	NO	349	NO	473	473	NO	822
2006	4443	NO	4443	NO	6859	6859	NO	11301	338	NO	338	NO	484	484	NO	822

The international marine bunkering emissions in 2006 dropped by 65 % compared to 1988, while the air bunkering emissions dropped less, i.e. by 35 %.

The main reason for that was the change of the methodology in 1999 for accounting of thankering of fuels on Bulgarian and foreign ships.

The decreasing of international aviation bunkering follow the decrease of international traffic due to a travel, cargo and others transportation.

Methodology

The GHG emissions were estimated, using the data from the Energy Balance of the country. The fuel quantities for sea and air transport were specified in the balance. Certain complications resulted from the fuel data for air transport, since the last was separated by domestic and international transport. That is why the fuels for international transport were determined by expertise.

During the international transport, the main GHG are emitted - CO_2, CH_4 and N_2O, GHG precursors - NO, CO, NMVOCs, as well as SOx. The GHG emissions were estimated by Tier 1 method with the emission factors determined based on the experimental and analytical studies, taking into account the country specific conditions (type and size of ships and airplanes, value of cargo, destinations etc.).

Table 3.18 shows the trends of main GHG and GHG precursors emissions.

Table 3.18 Trend in greenhouse gas emissions from International Bunkers 1988-2006, Gg

Source	Marine Bunkers	Gasoline	Gas/Diesel Oil	Residual Fuel Oil	Aviation Bunkers	Jet Kerosene	Gasoline	Total
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
CH_4								
1988	0.04	NO	0.04	NO	0.02	0.02	NO	0.06
1989	0.04	NO	0.04	NO	0.02	0.02	NO	0.06
1990	0.02	0	0.02	NO	0.04	0.02	0.02	0.06
1991	0.01	NO	0.01	NO	0.01	0.01	0.01	0.03
1992	0.01	NO	0.01	NO	0.02	0.02	0	0.03
1993	0.01	NO	0.01	NO	0.02	0.02	0	0.04
1994	0.01	NO	0.01	NO	0.02	0.02	0	0.03
1995	0.01	NO	0.01	NO	0.02	0.02	0	0.03
1996	0.01	NO	0.01	NO	0.01	0.01	0	0.03
1997	0.02	NO	0.02	NO	0.01	0.01	0	0.03
1998	0.01	NO	0.01	NO	0.02	0.01	0	0.03
1999	0	NO	0	NO	0.01	0.01	NO	0.01
2000	0.01	NO	0.01	NO	0.01	0.01	NO	0.02
2001	0.02	NO	0.02	NO	0.01	0.01	NO	0.03
2002	0.02	NO	0.02	NO	0.01	0.01	NO	0.04
2003	0.03	NO	0.03	NO	0.01	0.01	NO	0.05
2004	0.03	NO	0.03	NO	0.01	0.01	NO	0.04
2005	0.03	NO	0.03	NO	0.01	0.01	NO	0.04
2006	0.03	NO	0.03	NO	0.01	0.01	NO	0.04
N_2O								
1988	0.02	NO	0.01	0.01	NO	NO	NO	0.02
1989	0.02	NO	0.01	0.01	NO	NO	NO	0.02
1990	0.02	0	0.01	0.02	0	NO	0	0.02
1991	0.02	NO	0.01	0.02	0	NO	0	0.02
1992	0.02	NO	0.01	0.02	0	NO	0	0.02
1993	0.02	NO	0	0.02	0	NO	0	0.02
1994	0.02	NO	0	0.02	0	NO	0	0.02
1995	0.02	NO	0.01	0.02	0	NO	0	0.02
1996	0.02	NO	0	0.01	0	NO	0	0.02
1997	0.03	NO	0.01	0.02	0	NO	0	0.03
1998	0.03	NO	0.01	0.02	0	NO	0	0.03
1999	0	NO	0	0	NO	NO	NO	0
2000	0.01	NO	0.01	NO	NO	NO	NO	0.01
2001	0.01	NO	0.01	0	NO	NO	NO	0.01
2002	0.01	NO	0.01	NO	NO	NO	NO	0.01
2003	0.01	NO	0.01	NO	NO	NO	NO	0.01
2004	0.01	NO	0.01	NO	NO	NO	NO	0.01
2005	0.01	NO	0.01	NO	NO	NO	NO	0.01
2006	0.01	NO	0.01	NO	NO	NO	NO	0.01

In 2006 were emitted main GHG at the amount of 822.5 Gg CO_2-eq. The sea transport emitted 41%, and the air transport - 59%. After the big drop in 1999, all GHG emissions increased more than twice in 2006.

Uncertainty and consistency of time series

The uncertainty of this emission source category has never been estimated in Bulgarian inventory. As per scientific information, it is estimated to approx. 2%, which was too optimistic estimation. Considering the uncertainty of the emission factors in the transport an estimation of 8% is more realistic.

In 1999, a big drop of the data for sea bunkering fuels use is observed. This drop was due to the change of the statistical accounting in NSI and its harmonization in compliance with EUROSTAT.

3.3. Fugitive Methane Emissions from Coal Mining and Systems for Gas and Oil Extraction and Distribution

3.3.1. Description of Sources

The fugitive methane emissions from coal mining are one of the largest methane emission sources in Bulgaria. They are ranked 12-th place in key source list, with share more than 2% of overall emissions for the country in 2006. The fugitive emissions from systems for gas and oil extraction and distribution are also key source (24 places) and had a share of approx. 1% of overall GHG emissions.

Coal mining

The fugitive CH_4 emissions from coal mining were included in this category.

The coal in Bulgaria is mined in surface and underground mines. The main domestic resource – lignite, is mined in surface mines. in the complex MARITZA IZTOK. The yearly production is closely connected with the plans of electro energy production and amounts to 25-30 million tones. The local lignite has low caloricity – up to 1500 calories in kg, a high content of humidity and sulphur. The last provoked the necessity of building installation for desulphurization (the first started working at the end of 2002). As a result from the desulphurization, emissions of CO_2 are gained which are taken into account in the inventory.

Brown, black and anthracite coal is mined in underground mines. The basic yearly quantity amounts to 3 million tones for the last few years. In the base year, over 5 million tones of the same type of coal have been mined.

In Bulgaria considerable quantity of imported energy and coking coal are being used - over 4.5 million tones in the current year. At their transportation and processing no accidental methane emissions are observed.

Table 3.19 shows the fugitive methane emission trends in coal mining.

Table 3.19. CH_4 fugitive emissions from coal mining and handling 1988-2006

Source	Coal Mining and Handling					CH_4 Emissions		
	Underground Mines	Brown coal	Black coal	Anthracite coal	Surface Mines - lignite	Underground Mines	Surface Mines	Total
	kt	kt	kt	kt	kt	Gg	Gg	Gg
1988	5180	4984	131	65	29191	69.4	25.4	94.8
1989	4992	4799	130	63	29509	66.9	25.7	92.6
1990	3848	3705	100	43	27827	51.6	24.2	75.8
1991	3220	3092	86	42	25231	43.1	22.0	65.1
1992	3600	3352	203	45	26736	48.2	23.3	71.5
1993	3682	3419	222	41	25351	49.3	22.1	71.4
1994	3328	3155	144	29	25429	44.6	22.1	66.7
1995	3381	3187	170	24	27449	45.3	23.9	69.2
1996	3198	3060	119	19	28104	42.9	24.5	67.3
1997	2779	2677	88	14	26929	37.2	23.5	60.7

1998	2993	2902	78	13	27117	40.1	23.6	63.7
1999	2712	2590	122	0	22586	36.3	19.7	56.0
2000	2719	2602	118	0	23712	36.4	20.7	57.1
2001	2756	2646	98	12	23856	36.9	20.8	57.7
2002	2860	2766	83	11	23158	38.3	20.2	58.5
2003	2695	2644	43	8	24604	36.1	21.4	57.5
2004	2844	2811	33	1	23642	38.1	20.6	58.7
2005	2490	2481	9	0	22205	33.4	19.3	52.7
2006	2726	2699	27	0	22952	36.5	20.0	56.5

The fugitive methane emissions in 2006 were 1 187 Gg CO_2-eq. They marked an increase by 0.35% compared to the preceding year, due to the decreased mining of brown coal.

The fugitive methane emissions from the underground mining were about 65 % of the emissions of this source, although the coal quantities from underground mining was less than 10.6% of the overall coal mining in the country, expressed in natural (mass) units - tone.

Extraction, refining, transportation and distribution of oil and natural gas

This source included the CH_4 fugitive emissions from:

- Extraction of oil and natural gas;
- Supplies, transportation and refining of oil;
- Transport and distribution of natural gas in the country;
- Transit of natural gas for neighbouring countries;
- LPG supplies at the special gas stations.

Table 3.20 shows the trends of methane fugitive emissions from oil and gas systems.

Table 3.20a. Activity data from oil and gas

Sources/ Year	Oil				Natural Gas			Venting/ Flaring	
	Production	Transport	Refining/Storage	LPG - consumed	Production	Transmission	Distribution	Oil	Gas
	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
1988	3.29	545.83	547.53	0.01	0.3	246.6	207.7	551	0.7
1989	3.09	550.41	558.65	0	0.3	330.8	228.7	562	0.6
1990	2.54	353.23	353.5	0	0.5	336.5	225.7	356	0.9
1991	2.45	194.8	195.87	0	0.3	330.7	193.1	198	0.7
1992	2.24	103.09	102.55	0	1.3	321.3	170.1	105	2.5
1993	1.81	242.32	242.25	0	2.3	327.8	159	244	4.6
1994	1.54	296.11	296.1	0.01	1.9	328.8	159.7	298	3.8
1995	1.82	339.98	339.98	0	1.7	381.3	191.7	342	3.3
1996	1.38	295.83	295.83	0.02	1.4	384.4	195.6	297	2.8
1997	1.18	253.72	253.72	0.03	1.2	384.5	154.6	255	2.4
1998	1.36	236.28	236.28	3.06	1	390.1	137.2	238	1.9
1999	1.83	237.48	240.47	4.16	0.9	464.8	116	242	1.8
2000	1.92	223.72	226.06	9.84	0.5	520.7	122.5	228	1
2001	1.44	219.36	219.78	13.06	0.8	539.6	114.4	221	1.5

2002	1.59	221.84	222.09	15.05	0.7	552.9	100.4	224	1.4
2003	1.29	214.76	214.28	16.83	0.5	558.1	104.4	216	1.1
2004	1.28	225.01	224.75	17.29	11.2	552.2	99.8	226	22.3
2005	1.28	257.07	263.07	16.08	16.1	621.4	102.8	264	32.2
2006	1.17	301.86	302.43	16.08	15.711	505	103.1	304	31

Table 3.20b. CH_4 fugitive emissions from oil and gas

Sources/ Year	Oil					Natural Gas					Venting/Flaring			
	Oil	Production	Transport	Refining/Storage	LPG-consumed	Natural Gas	Production/Processing	Transmission	Distribution	Other Leakage	Venting/Flaring	Oil	Gas	Total
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg
1988	0.8	0.01	0.4	0.4	0	60.1	0.03	3.1	NE	57.0	0.02	0.01	0.01	**60.9**
1989	0.8	0.01	0.4	0.4	0	63.9	0.03	3.4	NE	60.5	0.02	0.01	0.01	**64.8**
1990	0.5	0.01	0.3	0.3	0	28.9	0.04	3.7	NE	25.1	0.02	0.01	0.01	**29.4**
1991	0.3	0.01	0.2	0.2	0	27.3	0.03	4.1	NE	23.2	0.01	0.01	0.01	**27.6**
1992	0.2	0.01	0.1	0.1	0	23.9	0.11	4.1	0.03	19.6	0.03	0.01	0.02	**24.1**
1993	0.4	0	0.2	0.2	0	24.0	0.19	4.4	0.03	19.4	0.05	0.01	0.04	**24.5**
1994	0.5	0	0.2	0.2	0	26.6	0.16	4.8	0.03	21.6	0.04	0.01	0.03	**27.1**
1995	0.5	0	0.3	0.3	0	30.5	0.14	5.1	0.03	25.2	0.04	0.01	0.03	**31.1**
1996	0.5	0	0.2	0.2	0	31.0	0.12	5.5	0.03	25.3	0.03	0.01	0.03	**31.5**
1997	0.4	0	0.2	0.2	0	27.3	0.1	5.9	0.04	21.3	0.03	0	0.02	**27.7**
1998	0.5	0	0.2	0.2	0.1	24.7	0.08	6.0	0.06	18.5	0.02	0	0.02	**25.1**
1999	0.5	0	0.2	0.2	0.2	20.6	0.08	6.4	0.12	14.0	0.02	0.01	0.02	**21.1**
2000	0.7	0.01	0.2	0.2	0.4	27.6	0.04	6.6	0.19	20.8	0.02	0.01	0.01	**28.3**
2001	0.8	0	0.2	0.2	0.5	25.2	0.06	6.4	0.31	18.5	0.02	0	0.01	**26.0**
2002	0.9	0	0.2	0.2	0.6	22.7	0.06	6.6	0.43	15.6	0.02	0.01	0.01	**23.7**
2003	1.0	0	0.2	0.2	0.6	23.3	0.04	6.6	0.56	16.0	0.01	0	0.01	**24.2**
2004	1.0	0	0.2	0.2	0.7	25.6	0.93	6.6	0.78	17.3	0.21	0	0.2	**26.8**
2005	1.0	0	0.2	0.2	0.6	28.6	1.35	6.6	0.98	19.7	0.3	0.01	0.3	**29.9**
2006	1.1	0	0.2	0.2	0.6	27.5	1.31	5.4	0.98	19.8	0.29	0.01	0.3	**28.9**

The CH_4 fugitive emissions from oil and gas, expressed in CO_2-eq. in 2006 were 606.08 Gg, or less than 1% of the summary GHG emissions. The emission reduce in 2006 was 3.6%, compared to 2005.

The extracted quantities of oil and gas in Bulgaria are very low and represent less than 1% from the consumption of these fuels in the country.

The methane fugitive emissions from the distribution gas networks in the industry and households were estimated by the quantities of natural gas in section Final energy consumption of the general energy balance of the country.

3.3.2. Methodology

The methane fugitive emissions from coal mining were estimated by method of the type Tier 1, as emission factors, given in IPCC Guidance, were used.

From the emission factors, given in IPCC Guidance, were chosen relevant values, considering that the underground mines have average depth not more than 400 m, and the surface mines for lignite have depth more than 25 m. According to the Good Practice Guidance, provided this is a key source, method that is more precise should be used. What is ahead is working out a methodology for more exact calculation of the underground mines emissions that will reach the level of Tier 2.

Applying of methods that are more precise is not possible at the present due to the limited data.

Calculation of CH_4 fugitive emissions from gas and oil systems was estimated by method of the type Tier 1.

Emission factors, given in Good Practice Guidance, are used for the 2006 inventory. They are estimated, as a rule, on a unit length of the pipelines, and they differed significantly from the standard parameters, specified in the Revised IPCC Guidance for the different regions of the world.

Table 3.21 shows the lengths of the natural gas distribution pipeline networks and their development since 1988.

Table 3.21 Development of the natural gas distribution pipeline network, km

Length of network	Natural Gas - transit	Natural Gas - domestic transmission	Natural Gas - domestic distribution	Total
1988	265	969	0	1234
1989	280	1070	0	1350
1990	300	1169	0	1469
1991	350	1269	0	1619
1992	375	1269	50	1694
1993	400	1369	50	1819
1994	450	1469	50	1969
1995	475	1569	50	2094
1996	605	1600	50	2255
1997	670	1700	60	2430
1998	710	1700	100	2510
1999	840	1700	200	2740
2000	945	1700	300	2945
2001	840	1700	500	3040
2002	945	1700	700	3345
2003	945	1700	911	3556
2004	945	1700	1260	3905
2005	945	1700	1577	4222
2006	945	1700	1777	4422

The data on crude oil and natural gas quantities was taken from the Energy balance of the country, where it was aggregated on a national level.

As it can be seen on **Table 3.20**, the broad use of LPG as a fuel for cars started in 1998, reaching almost 10% from the overall fuel consumption in the country in 2006.

Besides the fugitive methane emissions, significant NMVOCs emissions from gasoline refuelling at gasoline stations, and from its delivery from refineries, as well as NOx, CO and NMVOCs emissions from burning the refinery flame torch, can bee seen. These emissions were structured and calculated in sector Industrial processes.

3.3.3. Uncertainty and Consistency of Time Series

The uncertainty of this emission source category was estimated as follows:

- 200 % for coal mining;

- 50 % for oil and natural gas systems.

The changes of the refined oil trends showed a reduction by 46% in 1996, compared to 1988. In the next period the oil consumption was relatively steady, at levels about 220 PJ per annum, or approx. 5.4 million tones.

The natural gas consumption was reduced more than twice in 2006, compared to 1988. It was due to curtail industrial production from the fertilizers factories and it could not be compensated by the speed up gas consumption of households in the last years.

The quantities of transited natural gas had a steady growing trend. They increased about 10 times for the period 1988-2006.

CHAPTER 4 INDUSTRIAL PROCESSES

4.1. Overview

GHG emissions from the Industrial Processes sector are obtained because of the industrial technological processes and/or material products consumption. With this type of emissions, no combustion processes are involved.

The industrial process emissions encompass emissions from all main GHGs and GHG-precursors. Special attention is paid to industrial emissions and emissions from F-gases usage.

GHG emissions are grouped in the following sub sectors according to industries: Mineral products; Chemical industry; Metal production; Other production; Production of Halocarbons (HFCs, PFCs) and SF_6; Consumption of Halocarbons and SF_6 and Others.

In the **Other production (2D)** sub sector, emissions from the Food and drink industry and Pulp and paper production are included.

In the **Other (2G)** sub sector, emissions from gasoline transportation, refueling of vehicles with gasoline at petrol stations, and plastic and adhesive production have been included.

Halocarbons and sulphur hexafluoride - SF_6 emissions are differentiated in two separate sub sectors, due to their big variety as types of gases and very high global warming potential.

During the preparation of the national GHG inventory report for the year 2006 as well as for the preceding years, certain difficulties are encountered due to data confidentiality of some production processes and technologies. Therefore, the inventory report for 2006 overcomes those difficulties using NSI identified emission data according to the CORINAIR methodology.

GHG emissions trends are given in **Table 4.1**.

Table 4.1 Trend in greenhouse gas emissions from Industrial Processes, Gg

Gas/Categories	Mineral Products	Chemical Industry	Metal Production	Other Production	Mineral Products	Chemical Industry	Metal Production	Other Production	Other	Nitric Acid Production	SF_6-Gg CO_2-eqv.
	2A	2B	2C	2D	2A	2B	2C	2D	2G	2B2	F - gases
	CH_4									N_2O	
1988	3842	1751	2473	NO	NE,NO	0.04	3.49	NO	0.36	7.81	
1989	4028	1750	2474	NO	NE,NO	0.04	3.52	NO	0.33	7.43	
1990	4020	1717	1836	NO	NE,NO	0.02	2.76	NO	0.25	7.28	
1991	2590	1415	1393	NO	NE,NO	0.01	2.05	NO	0.14	5.25	
1992	2090	1163	1312	NO	NE,NO	0.01	1.94	NO	0.14	4.27	
1993	1908	1126	1639	NO	NE,NO	0.03	2.25	NO	0.17	3.65	
1994	2292	1263	2127	NO	NE,NO	0.03	3	NO	0.18	4.32	
1995	3124	1524	2316	NO	NE,NO	0.04	3.29	NO	0.2	6.2	1.26
1996	3174	1512	2094	NO	NE,NO	0.02	3.04	NO	0.2	6.33	1.31
1997	2845	1248	2254	NO	NE,NO	0.02	3.29	NO	0.2	5.21	1.75
1998	1402	673	1866	NO	NE,NO	0.21	2.62	NO	0.18	3.12	1.83
1999	2034	481	1704	NO	NE,NO	0.46	2.23	NO	0.07	2.36	1.88
2000	2302	813	1478	NO	NE,NO	0.15	3.37	NO	NO	4.24	2.23
2001	2469	725	1419	NO	NE,NO	0.14	2.28	NO	NO	4.18	2.29
2002	2403	464	1323	NO	NE,NO	0.13	2.06	NO	NO	3.51	2.51

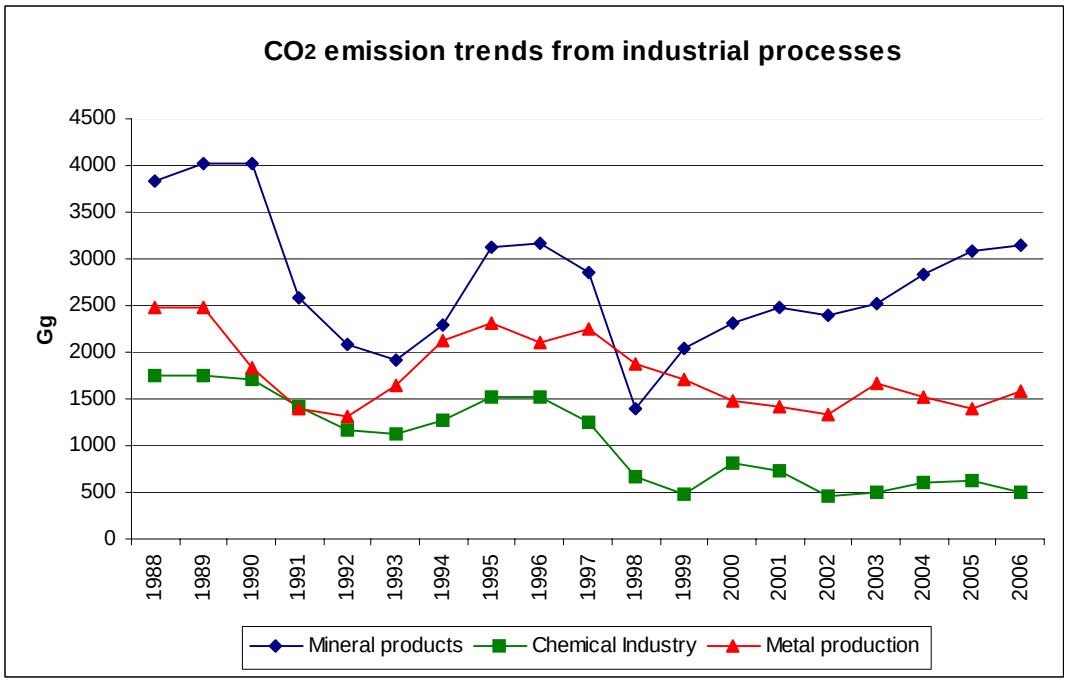
2003	2529	492	1658	NO	NE,NO	0.27	2.51	NO	NO	3.74	2.52
2004	2843	610	1522	NO	NE,NO	0.14	2.13	NO	NO	2.77	3.68
2005	3078	623	1398	NO	NE,NO	0.18	2.03	NO	NO	3.2	4.42
2006	3151	491	1592	NO	NE,NO	0.13	1.99	NO	NO	2.9	5.30

The main data source for the quantities of produced prime and raw materials and manufactured goods is the NSI.

The biggest share of the aggregated GHG emissions from sector Industrial Processes for 2006 has CO_2 – 84.7%, followed by N_2O with 14.6% and CH_4 with 0.7% in CO_2–eq.

CO_2 emission trends for the main categories are given in **Figure 4.1**.

Figure 4.1



The analysis of **Figure 4.1** reveals that the emission fluctuations follow the changes of economic activity. Key factors on macroeconomic level were:

- Changes in international markets;
- Privatization of state property;
- Others.

It can be noted that during the period after the year 2000, certain stabilization of CO2 emissions has been observed, and after 2002 - there is a tendency of an increase.

The following key sources are in the sector:

- CO_2 from steel production (ranked 9 with more than 2% share);
- CO_2 from cement production (ranked 10 with 2% share);
- CO_2 from quicklime production (ranked 16 with 1% share);
- N_2O from nitric acid production (ranked 18 with 1% share);
- F- gases emissions (ranked 23 with 1% share);
- CO_2 from ammonia production (ranked 27 with 1% share).

The ranking above is from the list of main emission sources, prepared according to the Tier 1 method, with an estimation of the emission level. Non-key sources from this list are:

- CO_2 from soda ash production;
- CO_2 from the production of other products;
- CH_4 from metal production;

GHG emissions are calculated following the default method according to the equation:

Emissions = Production * Emission factor,

where the **production** is in physical units (m^3, kg, m^2 etc.), the **emission factors** are in kg emissions per unit production.

The emissions factors, as a rule, are selected from the IPCC Guidelines but part of them are taken from the adapted in Bulgaria CORINAIR methodology (for the production of steel, ammonia, sinter and other).

4.2. Mineral Products

4.2.1. Source Description

Two key GHG sources contribute to the emissions in this sub sector, which are traditional in the economy of the country. These are the production of cement and lime.

CO_2 emissions from **cement production** are 1 488.4 Gg in the year 2006, which is 2% of the aggregated GHG emissions. During the last five years, there has been a stabilization of the production with a tendency for slight increase until 2006. The decrease of GHG emissions in 2006 is 4.1%, compared to 2005.

CO_2 emissions from **quick lime** production are 1038.4 Gg in the year 2006, which is more than 1% of the aggregated GHG emissions. The increase of the CO_2 emissions in 2006 compared to 2005 is 4.2%.

CO_2 emissions from **soda ash production** are 163.08 Gg in 2006. In 2006 the CO_2 emissions from the use of soda ash are about 43% from the emissions at the production of this product.

The CO_2 emissions from glass production are included in the **Other** emission source of the sector.

4.2.2. Methodology

The Tier 2 method from the Good Practice Guidance is used when determining the emissions from **cement production**. As the CO_2 emissions are correlated with data from the produced clinker – emission factors and quantities, their specification is made based on the produced clinker.

The quantities of **quick lime** are given by the NSI and the emission factors are adopted by the IPCC Guidelines.

The CO_2 emission factors at use of **limestone and dolomite** are accepted according to the data from the Revised Guidelines of IPCC, 1996.

Data for the quantities of **soda ash production** is confidential. Therefore, the determination of emissions follows a special methodology, coordinated with NSI.

4.2.3. Uncertainty and Consistency of Time Series

The uncertainty from emissions from the sub sector is within the 16-30% range and the higher percentage relates for the cement production. For the non-key sources, the uncertainty is 20%.

The CO_2 emission trend for Mineral products production is given in **Table 4.2.**

Table 4.2 CO_2 emissions from Mineral products 1988-2006, Gg

Years/ Sources	Cement Production	Lime Production	Lime-stone and Dolomite Use	Soda Ash[1]	Other[2]	Total
	2A1	2A2	2A3	2A4	2A7	
1988	2006	1118	458	233	27	**3842**
1989	2203	1136	409	259	21	**4028**
1990	2070	1222	482	222	24	**4020**
1991	1225	812	340	199	14	**2590**
1992	1062	572	314	131	11	**2090**
1993	1116	417	284	79	13	**1908**
1994	1395	522	244	114	17	**2292**
1995	1926	747	261	170	19	**3124**
1996	1897	778	296	181	22	**3174**
1997	1649	692	309	178	18	**2845**
1998	806	48	376	157	14	**1402**
1999	1051	561	312	102	8	**2034**
2000	1124	798	255	117	8	**2302**
2001	1166	918	246	130	9	**2469**
2002	1157	855	233	119	40	**2403**
2003	1211	921	205	129	62	**2529**
2004	1376	956	297	139	75	**2843**
2005	1552	996	314	146	70	**3078**
2006	1488	1038	329	163	132	**3151**

1 - Soda ash includes 2A4.1 Soda Ash Production and 2A4.2 Soda Ash Use
2 - Other includes Glass Production and Desulphurized Emissions

The analysis of **Table 4.2** shows a stable trend of the GHG emissions from the two main sources – cement and lime production.

4.3. Chemical Industry

4.3.1. Source Description

N_2O emissions from **nitric acid production** expressed in CO_2-eq. were 899.7 Gg for the year 2006. The emission decrease in 2006 is some 9.3% compared to 2005 as the current level remains higher than the level in 1999.

CO_2 emissions from **ammonia production** were 467.45 Gg for the year 2006. The decrease of emissions in 2006 is some 21.7% compared to 2005.

Non-energy emissions from the use of fuel in this sub sector are calculated and classified in the sub sector Chemistry of the Energy sector.

4.3.2. Methodology

The emission factors for the calculation of N_2O emission from **nitric acid production** are from the IPCC Guidelines.

The quantity of produced **ammonia** is provided by NSI and the emission factor is determined with a model. Therefore the emission factor in use is quite different from the standard value in the IPCC Guidelines.

4.3.3. Uncertainty and Consistency of Time Series

The uncertainty of N_2O emissions from nitric acid production has estimated at 200%. The uncertainty of CO_2 emissions from the production of ammonia is 21%.

The analysis of the trends of GHG emissions for this sub sector that are given in **Table 4.3,** shows a trend of significant reduction of GHG emissions in the year 2006 compared to 1988 – about three times for the ammonia and nitric acid production.

Table 4.3 GHG emissions from Chemical industry processes, Gg

Sources	Ammonia Production	Calcium Carbide	Nitric Acid Production
	CO_2		N_2O
1988	1662	89.3	7.8
1989	1642	108.7	7.4
1990	1620	96.5	7.3
1991	1353	61.8	5.2
1992	1120	43.2	4.3
1993	1095	30.3	3.7
1994	1232	30.6	4.3
1995	1490	34.6	6.2
1996	1479	33.4	6.3
1997	1216	31.4	5.2
1998	652	20.2	3.1
1999	468	12.3	2.4
2000	802	11.9	4.2
2001	718	6.8	4.2
2002	457	7.6	3.5
2003	484	8.3	3.7
2004	586	24.4	2.8
2005	597	26.3	3.2
2006	467	23.1	2.9

4.4. Metal Production

4.4.1. Source Description

CO_2 process emissions from the **steel production** are a key source contributing 2% of the total GHG emissions in the year 2006 – 1 548 Gg. This is the biggest source of GHG emissions in the Industrial Processes sector followed by the cement production.

CH_4 emissions from the production of metals are non-key GHG emission sources. These are emissions from production of pig iron, sinter and coke.

Non-energy emissions from fuel use in this sub sector are calculated and classified in the Iron and Steel production category of the Energy sector.

4.4.2. Methodology

The production quantities for the purposes of the inventory have provided by the statistics of NSI and the emission factors are determined by taking into account the steel

production technologies (basic oxygen furnace and electric arc furnace). For the purpose we use a method which using the analytical way calculates the emission factor using data from the adapted CORINAIR methodology used in NSI. Therefore this factor differs significantly from the recommended in the IPCC.

Guidelines aggregated emission factor for pig iron and steel production.

As a rule data for the produces quantities of steel, coke and pig iron is confidential. Therefore the GHG emissions have calculated following a special methodology coordinated with NSI.

4.4.3. Uncertainty and Consistency of Time Series

The uncertainty of CO_2 emissions from steel production has estimated at 10% and those of CH_4 emissions – at 20 %. Total uncertainty of F-gases has estimated at 51%.

The trends of GHG emissions in this sub sector are given in **Table 4.4**

The analysis of **Table 4.4** reveals significant decrease of GHG emissions in the year 2006 compared to 1988 – 34.4% for steel production, 54.1% for coke and 21.8% for pig iron.

The 2006 inventory report presents also potential HFC emissions, which are determined, based on import substances containing greenhouse gases - HFC-23, HFC-32, HFC-125, HFC-134a, HFC–152a, HFC-143a, HFC-227ea and C_3F_8. The potential GHG emissions are accounted when forming the summary of GHG emissions because the actual emissions are not valuated. By this the Good Practice Guidance of requirements are regarded.

Table 4.4 GHG emissions from Metal industry processes Gg

Sources	Steel	Ferroalloys Production	Pig Iron	Sinter	Coke	HFCs - potential	PFCs - potential	SF6 - potential
	CO_2		CH_4			F-gases		
1988	2360	113	1.29	1.46	0.73			
1989	2380	94	1.37	1.37	0.78			
1990	1793	43	1.03	1.04	0.69			
1991	1326	67	0.85	0.84	0.37			
1992	1273	38	0.75	0.77	0.42			
1993	1594	46	0.9	0.9	0.46			
1994	2045	82	1.3	1.15	0.56			
1995	2236	79	1.42	1.25	0.62	62.2		
1996	2017	77	1.33	1.13	0.58	109.3		
1997	2158	96	1.45	1.22	0.62	188.1		
1998	1837	29	1.25	0.97	0.4	576.6		
1999	1668	36	1.04	0.93	0.27	102.8		
2000	1458	20	1.99	0.9	0.47	96		29.4
2001	1391	28	1.01	0.88	0.4	97.5		2.39
2002	1305	18	0.97	0.71	0.38	89.6		2.39
2003	1640	18	1.21	0.88	0.42	120.6		6.36
2004	1505	17	1.01	0.71	0.42	217.3		0
2005	1376	22	0.97	0.68	0.37	386.8		0.96
2006	1548	44	1.01	0.65	0.33	610.7	0.04	4.83

4.5. Halocarbon and SF_6 Production

F-gases have not been produced in Bulgaria.

4.6. Halocarbon and SF_6 Consumption

4.6.1. Source Description

This emission source includes fugitive emissions of SF_6 from high voltage equipment where this gas has used as an insulator. The total emission of this source in the year 2006 is 5.30 Gg CO_2-eq.

4.6.2. Methodology

To determine the fugitive emissions of SF_6 from electrical equipment the proposal for emission factor from the Good Practice Guidance is applied.

NSI has no data on the actual consumption of HFCs according to the classification in the IPCC Guidelines namely gases used for the production of refrigeration and air conditioning equipment foam blowing fire extinguishers aerosols solvents and other applications (tobacco processing production of adhesive/glue ink paint etc.).

For the purpose of the GHG inventory report additional data has collected from all enterprises in the country using electrical commutation devices with SF_6. Thus the existing information has updated and fugitive SF_6 emissions from the operation of this kind of devices are recalculated.

4.7. Other Industrial Processes

4.7.1. Source Description

This source includes CO_2 emissions from glass and ferroalloys production and from desulphurization. The emissions for the year 2006 are 175.8 Gg. They increase by 92% compared to 2005 due to the increased emissions from the desulphurization process in the MARITZA IZTOK power stations.

4.7.2. Methodology

Data for the produced quantities from this source is given by NSI and the emission factors are adopted according to the IPCC Guidelines.

Data for calcium carbide is confidential. Therefore GHG emissions are calculated following special methodology.

4.7.3. Uncertainty and Consistency of Time Series

The uncertainty of CO_2 emissions from this source has estimated at 21%.

CHAPTER 5 SOLVENT AND OTHER PRODUCT USE

5.1. Overview

GHG emissions in the **Solvent and Other Product Use Sector** are result from the processes in the production and use of paint and adhesives, use of solvents in industry and households, dry cleaning, vegetable oil production, production of pharmaceuticals and anaesthesia. The emissions from this sector are mainly of NMVOCs and N_2O.

GHG inventories in Bulgaria use a simplified method for the calculation of NMVOCs emissions, which includes use of data from the GHG calculation following the CORINAIR methodology.

After the in-country review of UNFCCC Secretariat (October 2007) have been made sample calculations of N_2O and CO_2 emissions for category 3D according to recommended Swiss methodology. N_2O and CO_2 emissions have been calculated during the whole time-series.

5.2. NMVOCs emissions from Solvent and Other Product Use (IPCC sector 3A, 3B, 3C and 3D)

5.2.1. Source Description

NMVOCs emissions are described for the following activities:

- Use of paints (including water based paints);
- Paint and lacquer production;
- Use of chemicals for dry cleaning;
- Vegetable oil production;
- Use of adhesives;
- Use of solvents in industry and households;
- Production of pharmaceutical.

There are no key GHG emissions in this sector.

NMVOCs emissions amount to 35.37 Gg, which is 33% of the emissions of this gas in Bulgaria.

The emission growth in the year 2006 is 16.6 % compared to 2005 mainly due to increased use of paints solvents in the households.

5.2.2. Methodology

NMVOCs emissions are calculated with emission factors, given in the approved in Bulgaria methodology for the calculation with balancing methods of the emissions of harmful substances, emitted in the ambient air (approved with Order RD 77 from 03.02.2006 of MOEW). This methodology is prepared based on the CORINAIR methodology, taking into consideration the specifics of some metallurgy and chemical technologies of the country in 2000.

Due lack of data about the emissions from dry cleaning and use of paint and solvents the consistency of the time series after 1997 is not good enough.

5.2.3. Uncertainty and Consistency of Time Series

NMVOCs emissions are GHG-precursors and there is no data in the bibliography on their uncertainty.

The trends in NMVOCs emissions are given in **Table 5.1**.

Table 5.1 Trends in NMVOCs emissions from solvent and other product use, Gg

Gas/sub-source	A.Paint Application	B.Degreasing and Dry Cleaning	C.Chemical Products, Manufacturing and Processing	D. Other			Total
				Vegetable oil production	Use of lacquers and solvents	Pharmacy	
1988	0.14	0.00	1.25	3.11	8.99	0.13	**13.62**
1989	0.16	0.00	1.30	3.20	8.99	0.13	**13.77**
1990	0.13	0.00	0.83	2.51	8.67	0.12	**12.25**
1991	0.06	0.00	0.35	1.92	8.60	0.12	**11.04**
1992	0.08	0.00	0.35	2.32	8.48	0.12	**11.36**
1993	0.12	0.00	0.27	2.72	8.46	0.12	**11.69**
1994	0.16	0.00	0.28	2.54	8.43	0.12	**11.53**
1995	0.18	0.00	0.38	3.43	8.38	0.12	**12.49**
1996	0.21	0.00	0.45	2.88	8.34	0.12	**11.99**
1997	0.17	0.00	0.45	2.80	8.28	0.12	**11.82**
1998	1.09	0.00	4.95	1.88	8.23	0.12	**16.26**
1999	2.43	0.336	4.12	1.83	2.00	0.11	**10.83**
2000	0.52	0.035	0.70	1.84	7.48	0.11	**10.69**
2001	0.69	0.286	11.98	1.61	2.43	0.11	**17.10**
2002	0.59	0.014	11.96	1.22	3.24	0.11	**17.13**
2003	0.90	0.010	10.70	1.39	1.43	0.11	**14.54**
2004	1.17	0.005	18.60	1.24	2.54	0.11	**23.65**
2005	1.63	0.006	24.05	1.49	3.06	0.11	**30.34**
2006	1.64	0.003	28.22	1.49	3.91	0.11	**35.37**

The analysis of **Table 5.1** shows violation of the consistency of time series after 1997. This is due to the inclusion of a new emissions source - bitumen production used for covering the roads with asphalt and to the lack of data about dry cleaning.

5.3. N_2O emissions from Solvent and Other Product Use (IPCC sector 3D1 and 3D3)

In all inventories until 2006 submission, the use of N_2O for anaesthesia sub-category has not been determine due to missing of the appropriate methodology and data. After the in-country review of UNFCCC Secretariat during October 2007, ERT have recommended to use data from Switzerland's methodology for calculation of N_2O emissions from sub-category 3D (without NMVOCs emissions from vegetable oil). The estimates are based on the assumption that 60% of the operations that are reported for Switzerland are carried out in Bulgaria.

As well as N_2O from aerosol cans sub-category, after the ERT's recommendations, Bulgaria made estimates of these emissions that are based on the assumption, that the intensity of using aerosols is the same as in Switzerland (10 grimes per person per year of N_2O emissions).

5.4. CO_2 emissions from Solvent and Other Product Use (IPCC sector 3D5)

After the in-country review of UNFCCC Secretariat during October 2007, ERT have recommended determination of CO_2 emissions as a result from converting of NMVOCs emissions in a part of category 3D.

The estimates for CO_2 emissions from pharmacy sub-category where derived based on the conversion of non-methane volatile organic compounds (NMVOCs) applying the Swiss conversion coefficient (2.53 $GgCO_2$/Gg NMVOCs).

The CO_2 emissions estimates from the use of lacquers and solvent sub-category are based on the same conversion coefficient from NMVOCs to CO_2.

CHAPTER 6 AGRICULTURE

6.1. Overview

GHG emissions from **sector Agriculture** result from the activities during the production and processing of agricultural products, soil fertilization and animal manure processing and preservation.

All emissions from combustion processes for energy production are reported in the Energy sector while the emissions from agricultural machines are reported in the category Other Transportation of the Transport sub sector.

GHG process emissions in sector Agriculture are grouped in the following sub sectors:

- Enteric fermentation from domestic livestock;
- Manure management;
- Rice cultivation;
- Agricultural soils;
- Field burning of agricultural residues.

The processes and activities from the sub sectors given above emit mostly the gases CH_4 and N_2O.

During the process of field burning of agricultural residues, certain quantities of GHG precursors are emitted. Although the burning of stubble - fields is banned in Bulgaria. The practice shows that not only stubble-fields are burnt but also areas with crops with no economical value for their owners. Due to this fact in the inventories valuations of this source of emissions are made.

GHG emissions trends from the sector are given in **Table 6.1**.

The biggest CH_4 emission source in the sector is the sub sector Enteric Fermentation from domestic livestock.

The biggest N_2O emission source is the Agricultural Soils sub sector.

The following GHG emission sources emerge as key sources for the year 2006:

- Direct N_2O emissions from agricultural soils (ranked 15 with 1% share);
- CH_4 from Enteric fermentation - cattle (ranked 17 with more than 1% share);
- Indirect emissions of N_2O from the agricultural soil (ranked 19 with 1% share);
- N_2O from Pastures. Range and Paddock (ranked 26 with 1% share)
- N_2O emissions from manure treatment (ranked 27 with 1% share).

The ranking above comes from the list of key sources, drafted according to the Tier 1 method with an estimation of emissions level. Non-key sources from this list are:

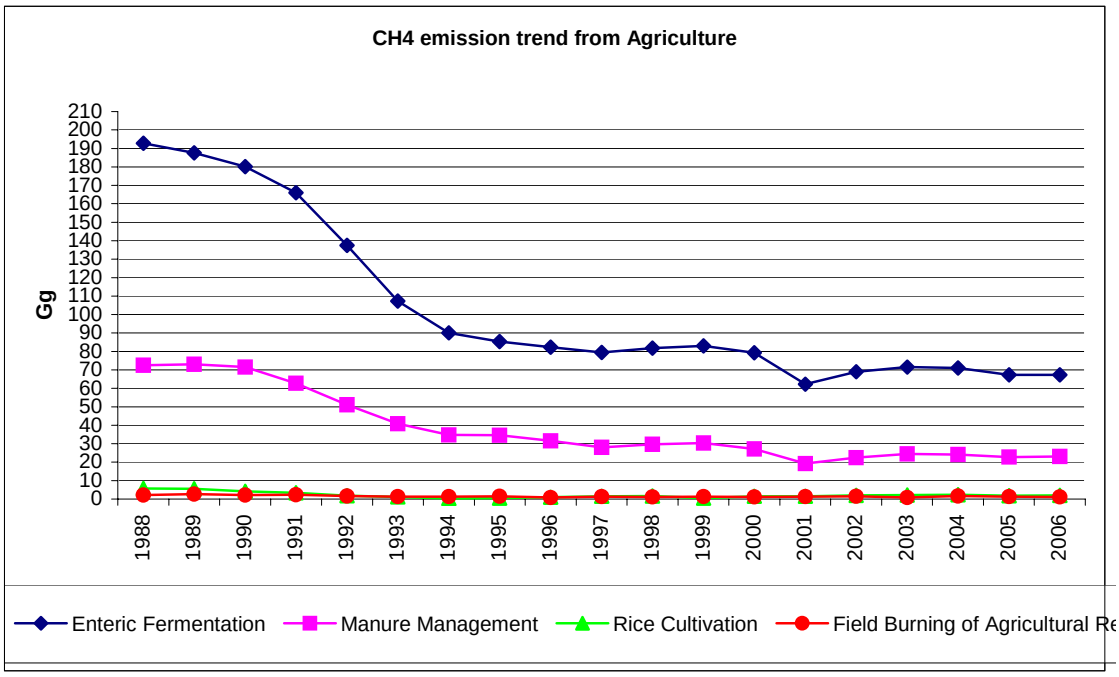
- Methane emissions from manure treatment;
- CH_4 emissions from rice cultivation;
- CH_4 emissions from field burning of agricultural residues;

• N_2O emissions from field burning of agricultural residues.

Table 6.1 Trend in greenhouse gas emissions from Agriculture, Gg

IPCC Sources	Enteric Fermentation	Manure Management	Rice Cultivation	Field Burning of Agricultural Residues	Manure Management	Agricultural Soils	Direct Soil Emissions	Animal Production	Indirect Emissions	Field Burning of Agricultural Residues
	4A	4B	4C	4F	4B	4D	4D1	4D2	4D3	4F
	CH_4				N_2O					
1988	192.79	72.55	5.68	2.21	3.41	25.00	10.56	5.33	9.11	0.05
1989	187.57	73.11	5.49	2.66	3.41	22.77	9.46	5.14	8.16	0.06
1990	180.17	71.49	4.26	2.20	3.32	20.93	8.43	4.96	7.53	0.05
1991	165.99	62.81	3.30	2.32	2.97	15.06	5.26	4.62	5.18	0.05
1992	137.48	51.10	1.82	1.62	2.45	12.01	4.02	3.83	4.15	0.04
1993	107.19	40.90	1.26	1.33	1.96	10.88	3.97	3.08	3.82	0.02
1994	90.13	34.72	0.33	1.40	1.64	11.02	4.37	2.76	3.89	0.03
1995	85.27	34.52	0.56	1.46	1.60	9.27	3.38	2.71	3.18	0.03
1996	82.38	31.60	1.05	0.81	1.49	9.02	3.17	2.65	3.20	0.02
1997	79.48	27.93	1.53	1.34	1.36	9.18	3.45	2.56	3.17	0.03
1998	81.77	29.64	1.61	1.19	1.46	7.91	2.66	2.55	2.70	0.02
1999	82.95	30.30	0.57	1.30	1.51	8.95	3.34	2.50	3.11	0.03
2000	79.28	27.08	1.44	1.15	1.38	8.61	3.25	2.34	3.02	0.02
2001	62.20	19.30	1.57	1.30	1.03	7.88	3.48	1.61	2.78	0.02
2002	68.97	22.42	2.11	1.50	1.19	8.03	3.49	1.74	2.80	0.03
2003	71.52	24.38	2.27	0.91	1.27	7.59	3.10	1.75	2.73	0.02
2004	70.95	24.05	2.30	1.61	1.26	8.40	3.73	1.73	2.94	0.03
2005	67.34	22.75	1.89	1.29	1.19	7.96	3.47	1.67	2.82	0.02
2006	67.33	23.15	2.05	1.24	1.60	7.67	3.35	1.68	2.64	0.02

Figure 6.1



Methane emission trends are given in **Figure 6.1**. They form 42% of the total emissions in the sector in CO_2-eq. A steady trend of emissions increase is observed since 2001.

N_2O emissions from the sector are also significant. The biggest share belongs to the agricultural soils emissions. It is about 82% in the year 2006 and for the entire period 1988-2003, the share is in the range of 82-87%. N_2O emissions from manure management and field burning of agricultural residues are of an order of magnitude smaller and in total are about 17% from the aggregated N_2O emissions of the sector.

In total, the N_2O emissions, expressed in CO_2-eq. for 2006, are 44% bigger than the CH_4 emissions in CO2-eq.

6.2. Enteric Fermentation

6.2.1. Source Description

The emissions from this key source result from the fermentation in the digestive system of ruminant animals. In Bulgaria are bred all domestic animals indicated in IPCC except for llamas and camels.

CH_4 emissions in CO_2-eq. were 1 414.0 Gg in the year 2006. A decrease in the year 2006 was 0.01% compared to 2005 and is due to a distribution of the basic type of animals.

6.2.2. Methodology

CH_4 emissions are determined using standard emission factors from the IPCC Guidelines in the framework of the Tier 1 method. These factors are summarized for different animal types, and only cattle are classified according to geographical regions principle. The inventory adopts cattle emission factor (including dairy cows) for the Eastern European region.

6.2.3. Uncertainty and Consistency of Time Series

The uncertainty from methane emissions from this source is 50%.

The methane emissions from the enteric fermentation of domestic livestock are given in **Table 6.2**.

The analysis of **Table 6.2** shows a steady trend of the emission growth after 2001. It is evident that the drop of 65% compared to 1988 can't be easily overcome in the next 10 years at such temps of rising.

The average number of animals per year is given in **Table 6.3**.

The time series for the different types of domestic animals has been consistent despite the change of the survey methodology in the year 2000.

Table 6.2 CH_4 emissions due to enteric fermentation for 1988-2006, Gg

Animal type	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Horses	Mules and Asses	Swine	Poultry	Total
	4A1	4A1	4A2	4A3	4A4	4A6	4A7	4A8	4A9	4A
1988	50.93	56.12	1.31	69.98	2.16	2.20	3.55	6.11	0.42	**192.79**
1989	50.15	54.60	1.28	66.96	2.17	2.17	3.52	6.34	0.39	**187.57**
1990	48.70	51.23	1.33	64.27	2.33	2.11	3.49	6.39	0.32	**180.17**
1991	47.41	44.71	1.39	58.57	2.63	2.07	3.48	5.50	0.25	**165.99**
1992	42.96	34.26	1.30	46.07	2.91	2.05	3.36	4.37	0.21	**137.48**
1993	36.68	22.92	1.08	34.31	3.22	2.04	3.22	3.56	0.16	**107.19**

1994	31.11	17.37	0.85	28.64	3.68	2.22	3.06	3.04	0.16	**90.13**
1995	29.12	15.43	0.75	27.12	4.07	2.55	2.95	3.09	0.19	**85.27**
1996	29.42	13.65	0.69	25.61	4.21	2.89	3.01	2.73	0.17	**82.38**
1997	30.12	12.60	0.60	23.47	4.54	2.87	2.89	2.24	0.15	**79.48**
1998	32.74	13.29	0.58	22.48	5.03	2.54	2.55	2.40	0.15	**81.77**
1999	34.52	14.02	0.54	21.29	5.23	2.47	2.30	2.43	0.15	**82.95**
2000	34.31	13.28	0.47	19.34	5.04	2.53	2.16	1.99	0.15	**79.28**
2001	27.57	13.13	0.37	12.10	3.14	2.62	2.03	1.08	0.16	**62.20**
2002	29.38	16.81	0.39	13.20	3.57	2.38	1.72	1.34	0.18	**68.97**
2003	29.16	19.59	0.42	13.31	3.70	2.16	1.46	1.52	0.20	**71.52**
2004	29.59	18.74	0.44	13.16	3.61	2.29	1.44	1.47	0.21	**70.95**
2005	29.02	16.15	0.44	13.18	3.32	2.23	1.40	1.41	0.20	**67.34**
2006	28.26	15.46	0.45	12.95	2.89	3.80	1.84	1.47	0.20	**67.33**

(*) Change from the base to the latest reported year

Table 6.3 Number of animals 1988-2006 (1 000 head)

Animal type	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Horses	Mules and Asses	Swine	Poultry
	4A1	4A1	4A2	4A3	4A4	4A6	4A7	4A8	4A9
1988	629	1002	24	8747	432	122	355	4076	41614
1989	619	975	23	8370	434	120	352	4225	39071
1990	601	915	24	8034	465	117	349	4259	32168
1991	585	798	25	7321	525	115	348	3664	24853
1992	530	612	24	5759	582	114	336	2911	20790
1993	453	409	20	4289	644	113	322	2376	16185
1994	384	310	15	3580	736	123	306	2029	15812
1995	360	275	14	3390	814	142	295	2063	18868
1996	363	244	13	3201	841	160	301	1820	17418
1997	372	225	11	2934	907	159	289	1490	15497
1998	404	237	10	2811	1007	141	255	1601	15226
1999	426	250	10	2661	1047	137	230	1617	15324
2000	424	237	9	2418	1008	141	216	1328	14977
2001	340	234	7	1512	629	146	203	718	16498
2002	363	300	7	1650	715	132	172	893	18072
2003	360	350	8	1663	740	120	146	1014	20036
2004	365	335	8	1646	722	127	144	982	20723
2005	358	288	8	1647	663	124	140	937	19514
2006	349	276	8	1619	579	211	184	978	19836

(*) Change from the base to the latest reported year

6.3. Manure Management

6.3.1. Source Description

Despite the fact that this emission source does not belong to the group of key sources, it remains one of the biggest CH_4 emitters out of all sectors, ranked 5-6 for the entire 1988-2006 period.

CH_4 emissions expressed in CO_2-eq. were 486.1 Gg for the year 2006. Their increase compared to the year 2005 is 1.7%, which is due to the slight general increase of the average annual number of livestock.

Manure management leads to N_2O emissions, which expressed in CO_2-eq. amount to 366.2 Gg during the year 2006. The emissions decrease is 0.9% compared to 2005.

N_2O emissions from this sub sector do not include animal waste from pastures.

6.3.2. Methodology

CH_4 emissions are determined according to the Tier 1 method using standard values from the IPCC Guidelines. Only for cattle (dairy and non-dairy) and swine, emission factors are calculated according to the Tier 2 method. Specific parameters for the systems for management and storage of manure have been given for this method in Bulgaria.

6.3.3. Uncertainty and Consistency of Time Series

The uncertainty of methane emissions from this source is 50% and of N_2O emissions - 300%.

The methane and N_2O emissions from manure management are given in **Table 6.4**.

Table 6.4 Trend in GHG emissions from Manure management 1988 –2006, Gg

Animal type	Dairy cattle	Non-Dairy cattle	Buffalo	Sheep	Coats	Horses	Mules and Asses	Swine	Poultry	Total	Manure manage-ment
	4B.1	4B.2	4B.2	4B.3	4B.4	4B.6	4B.7	4B.8	4B.9	4B	4B
	CH_4										N_2O
1988	11.51	12.23	0.22	2.45	0.08	0.25	0.41	40.54	4.87	**72.55**	**3.41**
1989	11.33	11.90	0.21	2.34	0.08	0.25	0.40	42.02	4.57	**73.11**	**3.41**
1990	11.00	11.17	0.22	2.25	0.08	0.24	0.40	42.36	3.76	**71.49**	**3.32**
1991	10.71	9.75	0.23	2.05	0.09	0.24	0.40	36.44	2.91	**62.81**	**2.97**
1992	9.71	7.47	0.21	1.61	0.10	0.24	0.38	28.95	2.43	**51.10**	**2.45**
1993	8.29	5.00	0.18	1.20	0.12	0.24	0.37	23.63	1.89	**40.90**	**1.96**
1994	7.03	3.79	0.14	1.00	0.13	0.26	0.35	20.18	1.85	**34.72**	**1.64**
1995	6.58	3.36	0.12	0.95	0.15	0.29	0.34	20.52	2.21	**34.52**	**1.60**
1996	6.65	2.97	0.11	0.90	0.15	0.33	0.34	18.10	2.04	**31.60**	**1.49**
1997	6.80	2.75	0.10	0.82	0.16	0.33	0.33	14.82	1.81	**27.93**	**1.36**
1998	7.40	2.90	0.09	0.79	0.18	0.29	0.29	15.92	1.78	**29.64**	**1.46**
1999	7.80	3.06	0.09	0.75	0.19	0.29	0.26	16.08	1.79	**30.30**	**1.51**
2000	7.75	2.89	0.08	0.68	0.18	0.29	0.25	13.21	1.75	**27.08**	**1.38**
2001	6.23	2.86	0.06	0.42	0.11	0.30	0.23	7.14	1.93	**19.30**	**1.03**
2002	6.64	3.66	0.06	0.46	0.13	0.28	0.20	8.88	2.11	**22.42**	**1.19**
2003	6.59	4.27	0.07	0.47	0.13	0.25	0.17	10.09	2.34	**24.38**	**1.27**
2004	6.68	4.09	0.07	0.46	0.13	0.26	0.16	9.77	2.42	**24.05**	**1.26**
2005	6.56	3.52	0.07	0.46	0.12	0.26	0.16	9.32	2.28	**22.75**	**1.19**
2006	6.39	3.37	0.07	0.45	0.10	0.44	0.21	9.73	2.32	**23.08**	**1.18**

The analysis of **Table 6.4** shows increase of methane emission for the present inventory, compared to the emissions from the preceding year and maintaining the low level compared to the base 1988 year – i.e. 68% reduction.

6.4. Rice Cultivation

Rice cultivation is a traditional Bulgarian agricultural activity. During the structural reforms, rice crop areas decreased from 14 100 ha in 1988 to 1 417 ha in 1999. There has been a restoration of rice crop areas after 1999, reaching 5 082 ha in 2006.

42.9 Gg CH_4 CO_2-eq. has been emitted in 2006. The emission increase of 8.5% compared to the year 2005 is due to the extent of the areas of rice crops.

CH_4 emission calculation is carried out according to the default method from the IPCC Guidelines. The value adopted as an emission factor is based on expert assessment taking into consideration the water regime for the rice crops in Bulgaria.

6.5. N_2O Emissions from Agricultural Soils

6.5.1. Source Description

The emissions from this sub sector include the following main categories N_2O emissions:

• Direct emissions;

• Emissions from pasture animals;

• Indirect emissions.

These three categories above are key sources in the year 2006.

Direct emissions are a result of:

• Soil fertilization with synthetic nitrogenous fertilizers;

• Nitrogen input from manure applied to soils (excluding manure from pasture animals);

• Decomposition of waste from N-fixing crops;

• Decomposition of vegetable waste from other cultures;

• Cultivation of histosols.

The emissions of pasture animals include emissions from the excretion on pasture range and paddock.

Indirect emissions include:

• ammonia and nitrous oxides release in the ambient air after nitrogen fertilization;

• emissions from drawing of water.

Activities described above are differentiated according to the IPCC classification. One has to take into consideration that the existing emissions of methane from soil are considered natural (non-anthropogenic) and are not subject of the inventory.

Direct N2O emissions were 1 039.3 Gg CO2-eq. in 2006, which is more than 1% of the aggregated GHG emissions during the year. The emission decrease in 2006 compared to 2005 is about 3% due to the smallest quantities of synthetic nitrogenous fertilizers and manure deposited in soils.

Table 6.5 N_2O emissions from Agricultural soils, Gg

Nitrogen flows (t N/yr)	Direct soil emissions	Use of synthetic fertilizers	Nitrogen input from manure applied to soils	N- fixing Crops	Crop Residue	Cultivation of histosols	N excretion on pasture range and paddock	Indirect soil emissions	Total
1988	10.56	7.65	1.92	0.06	0.92	0.003	5.33	9.11	**25**
1989	9.46	6.34	1.93	0.08	1.11	0.003	5.14	8.16	**22.77**
1990	8.43	5.6	1.86	0.05	0.92	0.003	4.96	7.53	**20.93**
1991	5.26	2.62	1.62	0.06	0.97	0.003	4.62	5.18	**15.06**
1992	4.02	1.97	1.32	0.05	0.68	0.003	3.83	4.15	**12.01**
1993	3.97	2.34	1.05	0.03	0.55	0.003	3.08	3.82	**10.88**
1994	4.37	2.87	0.88	0.03	0.58	0.003	2.76	3.89	**11.02**
1995	3.38	1.83	0.88	0.05	0.61	0.003	2.71	3.18	**9.27**
1996	3.17	2.01	0.8	0.03	0.34	0.003	2.65	3.2	**9.02**
1997	3.45	2.16	0.7	0.03	0.56	0.003	2.56	3.17	**9.18**
1998	2.66	1.38	0.76	0.03	0.49	0.003	2.55	2.7	**7.91**
1999	3.34	1.98	0.79	0.02	0.54	0.003	2.5	3.11	**8.95**
2000	3.25	2.05	0.72	0.01	0.47	0.003	2.34	3.02	**8.61**
2001	3.48	2.38	0.56	0.01	0.53	0.003	1.61	2.78	**7.88**
2002	3.49	2.2	0.66	0.01	0.62	0.003	1.74	2.8	**8.03**

2003	3.1	1.99	0.72	0.01	0.38	0.003	1.75	2.73	**7.59**
2004	3.73	2.33	0.72	0.01	0.66	0.003	1.73	2.94	**8.4**
2005	3.47	2.26	0.67	0.01	0.53	0.003	1.67	2.82	**7.96**
2006	3.35	2.16	0.64	0.01	0.53	0.003	1.68	2.64	**7.67**

Indirect N_2O emissions were 818.8 Gg CO_2-eq. in 2006. These category emissions also decreases with a little more than 6% compared to 2005.

The emissions from pasture animals increase by 0.7% compared to 2005.

6.5.2. Methodology

The emissions from this source are determined after a selection of parameters, indicators and emission factors. given as prototypes in the IPCC Guidelines. So far, there are no assessments of these parameters and emission factors. which result from the measurements in the country.

The manure quantity is calculated using the prototype parameters for different types of animals in the Eastern Europe region. given in the IPCC Guidelines. The synthetic fertilizers quantities are provided by the National Service for Plant Protection at the Ministry of Agriculture and Food Supplies.

6.5.3. Uncertainty and Consistency of Time Series

The uncertainty from the direct N_2O emissions from this source is 250% and from the indirect emissions - 500%.

N_2O emissions from this source for all categories in the sub sector are given in **Table 6.5**.

The consistency of time series for the source categories given in **Table 6.6** is provided due to lack of changes in the methodology and in the source of data.

6.6. Field Burning of Agricultural Residues

CH_4 emissions from this source result from field burning. Despite the fact that field burning is prohibited. this tradition continues and is emission source not only of main GHGs but also of GHGs-precursors.

33.5 Gg CO_2-eq. aggregated GHGs has been emitted in 2006. The decrease is 3.6%, compared to the year 2005, on the assumption that 10% of the vegetal residues, left on the fields after yielding crop. are burned.

The crop residues quantities are calculated under the methodology of IPCC based on data from MAFS (Ministry of Agriculture and Food Supplies) for the quantities of vegetable crop yields.

CHAPTER 7 LAND USE, LAND-USE CHANGE AND FORESTRY

7.1. Overview

The Land-Use Change and Forestry sector covers the processes of CO_2 exchange between the biomass sources (forests, grass and other stands, soils, etc.) and the atmosphere. The CO_2 flow exchange from and to the atmosphere is a set of processes, which result from anthropogenic activity. For example, CO_2 sequestration by forests is related to forest management and use of woodlands aimed at industrial timbering. The reforestation of uncultivated lands, aimed at erosion control, also results in CO_2 accumulation in biomass.

CO_2 emissions in the atmosphere are related to thinning and burning of forests to convert them in agricultural lands, and because of changes in the organic compounds of the soils due to erosion or chemical treatment.

Due to the significant complexity and heterogeneity of the CO_2 removal and emission processes, the Revised IPCC Guidelines (2000) define several sub sectors, which encompass the following categories:

A. Changes in Forest and other woody biomass stocks.

This category includes the processes of woody biomass growing, felling and timbering. As a rule, the net carbon balance in Bulgaria is in the direction of CO_2 removal from the atmosphere.

B. Forest and Grassland conversion.

These activities aim at the conversion of land for agricultural use for the production of crops and animal breeding.

C. Abandonment of managed lands.

These are agricultural lands (fields, pastures, plantations, etc.) which resume their initial vegetation cover (woody or grassy).

D. CO_2 emissions and removals from soil.

This category includes processes and activities that change the organic composition of the soils. Such is the introduction of minerals during soil treatment, erosion process, etc.

E. Other.

This category includes activities, which also result in changes of CO_2 flows from and to the atmosphere. Such are soil drainage, shifting the cultivation periods of crop farming (mostly in the tropical regions), succession of longer and shorter cultivation periods.

By introduction of Good Practice Guidance for LULUCF, especially for this sector, conditions appeared for better covering of the emission sources. For this purpose CRF tables of new types have been invented, which are united in a new general format for reporting.

The new Guidance includes the five categories described above in more enlarged meaning and range. The different kinds and types of vegetations and plants are classified in the following sections:

– Forests

– Plants (grain crops, industrial crops and others)

– Meadows, pastures and other lawns

– Swampy and marshy areas

– Wood and other plantations in towns and villages, protective forest belts and others

– Other lands

For each of the above-mentioned sectors are defined two conditions of forests (plant areas, meadows and others), which **remain** forests or respectively crop fields and others, and lands which distinguish from forests, but are **converted** to forests (plant areas, meadows and others). In this way, all the possible changes of lands and the land using are covered. Six groups, which include all lands and their changes that have relation to the relevant section given above, are formed this way.

The carbon balance of the following activities is described to each of these groups:

– Alteration of the biomass in the over-ground of woods etc.,

– Alteration of the dead biomass (decayed etc.),

– Alteration of the carbon reserves in the relevant soil (forest, field, and meadow

etc.)

During the analysis of the biomass in the types of soil formed in that way, results including all the aspects of the land using and the alteration of lands come out.

Besides the above-described actions, it is reported information about:

– Synthetic nitrogen fertilizers brought in the forest soils;

– N_2O emissions from draining of forest etc.;

– Liming of soils;

– N2O emissions from converting in agricultural lands with grain crops;

– Burning of biomass.

For each above-described activity and category there is algorithms submitted in the GPG-PA.

In the 2006 GHG inventory, and for the preceding years, the net CO_2 removal from category A – Changes in Forest and other woody biomass stocks have been determined.

7.2. CO_2 sinks from Forestry

7.2.1. Source Description

Bulgarian forests belong to the temperate climate zone. For the most part they are two types – deciduous and coniferous.

The forests in Bulgaria cover about 33% of the territory of the country. The terrain varies and presumes the presence of big forest lands in the mountain and semi mountain areas of Central and Southern Bulgaria.

In 2006 the total forests area in Bulgaria (deciduous and coniferous) was 4089.762 thousand ha. The total area of the managed woods from this fund is 3668.795 thousand

ha or 89.7%. More than 79% of the forests are state property, 10% are municipal and 10% are private property. The forest areas for timbering and site formation are 57%, the protective and recreational forests – 27% and protected forest and territories – 16%.

The wood stock is more than 598.81 millions m^3 with an average annual growth of 14.12 millions m^3. The volume of cut wood was 7.234 millions m^3 in 2006.

Essential characteristics of the Bulgarian forests are:

- Average volume per 1 ha – 162 m^3;

- Average increment per 1 ha – 3.9 m^3;

- Average age – 51 years;

- Average density – 0.72;

- Average yield class- III.

7.2.2. Methodology

During the GHG inventory, data for stocked carbon and changes in forests was based on the following elements:

• forest area, in ha;

• average annual growth in m^3/ha/year;

• harvest biomass in m^3/year.

The Forest Law carries out the control on the management and use of forest areas. It sets common rules to which are subjects all forests (according to ownership, type of forest, purpose and other characteristics).

The average annual growth of the forests is determined following a special methodology of the forestry authorities once in each five years within the framework of the successive forest inventory.

The volume of the harvested wood is determined annually based on preliminary plans for felling and as a result of real organized felling.

7.2.3. Uncertainty and Consistency of Time Series

CO_2 removal is formed by the net balance of the atmosphere absorbed C and the volume of cut biomass (wood) used for heating, pulp production and other biomass consuming activities.

The analysis of the CO_2 removals trend from the forest shows a significant change for the period 1988-1991 in the range of 5 100 - 7 700 Gg, a relative stabilization during the period 1992-1995 at a level of about 7 500 Gg, a drop in the year 1996 to 6 500 Gg and a following steady tendency of increase until 2001. After this period of steady increase follows a drop due to increased felling.

The quantities of CO_2 removals from forests are given in **Table 7.1** for the entire GHGs inventory period (1988-2006).

Table 7.1 CO_2 emission/removals from changes in forest and other woody biomass stocks, [Gg]

Year	Carbon uptake increment	Carbon release	Carbon net uptake	Net CO_2 removals
1988	2761.0	-1361.2	1399.8	**-5132.6**
1989	2861.5	-1326.2	1535.3	**-5629.3**
1990	2961.9	-1282.7	1679.2	**-6157.0**
1991	3062.3	-979.9	2082.5	**-7635.7**
1992	3162.8	-1141.3	2021.5	**-7412.0**
1993	3263.2	-1224.4	2038.8	**-7475.8**
1994	3321.0	-1329.6	1991.4	**-7301.7**
1995	3361.5	-1309.4	2052.1	**-7524.5**
1996	3361.5	-1584.0	1777.5	**-6517.5**
1997	3361.5	-1487.4	1874.1	**-6871.5**
1998	3361.5	-1490.5	1871.0	**-6860.5**
1999	3361.5	-1397.9	1963.6	**-7199.8**
2000	3697.7	-1249.6	2448.1	**-8976.2**
2001	3697.7	-1115.7	2581.9	**-9467.1**
2002	3697.7	-1429.1	2268.6	**-8318.1**
2003	3697.7	-1773.3	1924.4	**-7056.0**
2004	4110.4	-1938.1	2172.3	**-7965.2**
2005	3812.5	-1904.4	1908.0	**-6996.0**
2006	3812.5	-1904.4	1908.0	**-6996.0**

7.2.4. Planned Improvements

The inclusion of sector 5B is not a question of present interest because after the restitution of the agricultural lands to their owners, there is no need of additional areas of arable land. On the contrary – some portion of the arable land is still not used on purpose and is deserted.

The responsible body for ensuring the QA/QC of the activity data is the State Forestry Agency. It should provide disaggregated forest data to MOEW (and GHG inventory team of ExEA) with written documentation on methodology.

To the end of 2008 will finish the project for establishment of QA/QC system of inventories.

CHAPTER 8 WASTE

8.1. Overview

GHG emissions in the Waste sector result from the processes of collection, storage and management of solid waste from household and the public sector and wastewater treatment from household and industry.

According to the IPCC nomenclature, the following categories in this sector are considered:

- Solid waste disposal;
- Wastewater handling;
- Waste incineration;
- Other.

Only the first two categories from those mentioned above are included in inventory for Bulgaria.

The methane and N_2O emission trends in this sector are given in Table 8.1.

Table 8.1 Trend in GHG emissions from Waste handling, Gg

IPCC Sources	Solid waste disposal	Waste water handling	Waste incineration	Waste water handling
	6A	6B	6C	6B
	CH_4			N_2O
1988	504.2	87.9	NE	1
1989	508.1	77.4	NE	0.96
1990	510.1	66.5	NE	0.72
1991	505.5	51.7	NE	0.65
1992	499.6	47.3	NE	0.65
1993	491.2	40.1	NE	0.62
1994	481.3	37.3	NE	0.59
1995	469.5	49.3	NE	0.54
1996	455.3	46.9	NE	0.52
1997	439.4	39.8	NE	0.46
1998	421.4	34.3	NE	0.52
1999	405.5	30.1	NE	0.53
2000	391.7	28.3	NE	0.5
2001	378.8	22.9	NE	0.48
2002	367.0	21.8	NE	0.49
2003	356.4	58.5	NE	0.49
2004	346.1	58.7	NE	0.48
2005	337.2	31.1	NE	0.47
2006	326.0	27.5	NE	0.47

Two key GHG emission sources are given in Table 8.1:

- Methane emissions from solid waste disposal (ranked 2 with more than 9% share);
- Methane emissions from wastewater handling (ranked 25 with 1% share).

N_2O emissions from wastewater handling are a non-key source. There are reported nitric oxides emissions from the consumption of proteins by the population.

8.2. Solid Waste Disposal

8.2.1. Source Description

Solid waste can be managed by disposal in landfills, recycling, and incineration for elimination or energy production. GHG emissions in this sector are accounted for only for the disposed solid waste.

As mentioned above, the emissions from this source are key sources only for the level estimation in the total GHG emissions (see Annex 1).

The emissions from this source are ranked first amongst the methane emissions in Bulgaria in 2006, and ranked second amongst all sources of GHG emissions in the country.

In accordance to certain criteria like:

- the presence of mechanical cover materials;
- leveling of waste.

and others Bulgarian depots are classified up to 2004 as controlled and un-controlled. After the Change of the Bulgarian Waste Law, the concept un-controlled depots dropped out. The criteria analysis given in the Revised IPCC Guidelines gives us grounds to classify all controlled depots to the "managed SWD" category.

8.2.2. Methodology

Solid wastes disposal emit CH_4 because of the processes of anaerobic and aerobic decomposition of their organic content. The current inventory, as the previous inventories assumes that the emitted methane is 50% of the total emitted biogas from the landfills.

For the determination of the quantities, emitted methane is used methodology that is more precise – Tier 2 from the IPCC Guidance. This methodology requires long enough historical time series of data for the solid waste disposals, which was given by NSI. The use of this methodology suits the requirements of the Good practices, because it is a key-source.

The parameters used in Bulgaria were given in Table 8.2, also parameters necessary for the Tier 2 methodology are included. Following the recommendations done by review team, the two main parameters Lo and K was re-calculated with maximum accounting of the specific county conditions and practice.

8.2.3. Uncertainty and Consistency of Time Series

The uncertainty of the emissions from this source is estimated at 101%.

The trend analysis shows that CH_4 emissions from solid waste disposal decrease almost lineally from 504.2 in 1988 to 326 Gg in 2006.

8.3. Wastewater Handling

8.3.1. Source Description

The second biggest CH_4 source in this sector is wastewater handling. This source is ranked third amongst all methane sources in the Bulgarian inventory.

N_2O emissions from wastewater handling are not a key source.

Treatment of **industrial wastewater** handling and **domestic and public buildings wastewater** handling is considered in separate groups.

Wastewater handling is a CH_4 source of emissions in anaerobic conditions. The conditions for anaerobic and aerobic processing are usually combined, which is reflected by the introduction of a correction factor.

8.3.2. Methodology

The determination of CH4 emissions follows the standard methodology given in the IPCC Guidelines. It comprises of the following steps:

1. Determination of the total amount of organic matter in wastewater and sludge in respect to the systems for their handling;

2. Estimation of the emission factors for each wastewater handling system;

3. Calculation of CH_4 emissions via multiplication of the total organic amount by the emission factors for each wastewater handling system.

Household data has higher uncertainty level as some average parameters per capita of the population have been used.

There is statistics for the industrial wastewaters according to types of industry, which allows accounting the diverse degradable organic matter in the related industry. This leads to higher precision for methane emission estimation.

Using Tier 1 methods for this type of non-key source corresponds to the good practice requirements.

8.3.3. Uncertainty and Consistency of Time Series

The uncertainty of the emissions estimation from this source is given at 85%.

CH_4 emissions from wastewater handling, expressed in CO_2-eq., amount to 578 Gg in 2006, which is 1% of the total GHG emissions. CH_4 emissions from industrial wastewater are the dominant here, forming 65% of the total CH_4 emissions from wastewater.

The trend analysis of the industrial wastewater shows a steady tendency for a decrease, reaching its minimum in 2002. However, there is a rapid rise in 2003 compared to the preceding year. The reason for this is the decision of the Ministry of Environment and Water for the discharge of several big tailing ponds in the country. This high level of the emissions of wastewater is kept in 2004 due to the same reason. In the present inventory this reason is omitted and the level of that kind of emissions is almost 2 times less.

Wastewater with nitrogen content, which is released as N_2O in the atmosphere, results from food consumption by the population. N_2O emissions, expressed in CO_2-eq., amount to 145 Gg in 2006. The decrease is 1.5% compared to 2005. It reflects not only the decrease of population, which is 0.51%, but also the decreased consumption of some foods (bread, milk, sugar, vegetables and others).

8.4. Waste Incineration

Bulgaria has no solid waste incineration for energy production.

8.5 Recalculation of methane emissions from MSW after in-country review of UN team in October 2007

After corrections of the parameters L_o and K, the methane emissions were recalculated for all years in period 1988-2006.

Table 8.2 Parameters used in the IPCC Tier 2 method for Solid Waste handling

	Description								Composition of landfilled wastes, %					
	Waste generation rate (kg/capita/day)	Fraction of MSW disposed to SWDS	Fraction of DOC in MSW	Fraction of wastes incinerated	Fraction of wastes recycled	CH4 fraction in landfill gas	CH4 generation rate, constant (k)	Time delay, years	Paper and paperboard	Food and garden waste	Plastics	Glass	Textiles	Other
1988	2.36	0.95	0.25	NO	NO	0.5	0.1	28	NA	NA	NA	NA	NA	NA
1989	2.17	0.95	0.25	NO	NO	0.5	0.1	29	NA	NA	NA	NA	NA	NA
1990	2.44	0.95	0.25	NO	NO	0.5	0.1	30	NA	NA	NA	NA	NA	NA
1991	2.59	0.95	0.25	NO	NO	0.5	0.1	31	NA	NA	NA	NA	NA	NA
1992	2.59	0.95	0.25	NO	NO	0.5	0.1	32	NA	NA	NA	NA	NA	NA
1993	2.37	0.95	0.25	NO	NO	0.5	0.1	33	NA	NA	NA	NA	NA	NA
1994	1.92	0.95	0.25	NO	NO	0.5	0.1	34	NA	NA	NA	NA	NA	NA
1995	1.47	0.99	0.25	NO	NO	0.5	0.1	35	NA	NA	NA	NA	NA	NA
1996	1.32	0.99	0.25	NO	NO	0.5	0.1	36	NA	NA	NA	NA	NA	NA
1997	1.2	0.97	0.25	NO	NO	0.5	0.1	37	NA	NA	NA	NA	NA	NA
1998	1.06	0.99	0.25	NO	NO	0.5	0.1	38	NA	NA	NA	NA	NA	NA
1999	1.07	0.99	0.25	NO	NO	0.5	0.1	39	NA	NA	NA	NA	NA	NA
2000	1.12	0.99	0.25	NO	NO	0.5	0.1	40	9	40	9	5	3	34
2001	1.11	1	0.25	NO	NO	0.5	0.1	41	10	39	9	5	4	33
2002	1.12	1	0.25	NO	0	0.5	0.1	42	11.1	39.5	11.1	5.3	3.8	29.2
2003	1.13	1	0.25	NO	0.01	0.5	0.1	43	10.3	39.58	11.7	5.01	4.1	29.3
2004	1.09	1	0.25	NO	0.01	0.5	0.1	44	10.14	37.8	13.58	5.59	4.35	26.06
2005	1.15	0.97	0.25	NO	0.01	0.5	0.1	45	5.91	47.83	7.59	3.19	2.53	32.95
2006	0.98	0.97	0.25	NO	0.01	0.5	0.1	46	5.91	47.83	7.59	3.19	2.53	32.95

CHAPTER 9 OTHER (SECTOR 7 FROM CRF)

This sector from the IPCC classification is designated to submit all GHGs emission sources, which for one or another reason have not been categorized at one of the six preceding sectors.

The Bulgaria inventory has no such specific sources to be reported in this sector.

Even so, the Other category can be commented here, because it is used in various places in the inventory.

The Other category appears in each sector, described in the preceding Chapters 2-8. It includes emission sources that belong to the sector but cannot be related to, and included in any of the categories of the sector.

Bulgaria has GHG emissions, which are not included in the inventory, so in future, research on their actual volume, and influence on the total GHG emissions in the country should be conducted. Such sources are:

- forest fires;
- use of candles for various purposes;
- drinking water purification;
- gas emissions from food stores.

CHAPTER 10 RECALCULATION OF GHG EMISSIONS AND IMPROVEMENTS

10.1. Explanations and justifications for recalculations

The GHG emission recalculation for the period 1988-2006, was made because of changes, made in some of the elements of the inventory (data, emission factors and others) for each sector as follows:

Energy

- Energy industries – Manufacture of Solid Fuels and Other Energy Industries (IPCC sector 1A1c) – the activity data about the consumed quantities of blast furnace gas for 2005 is corrected;

Solvent and Other Product Use

- N_2O emissions from Solvent and Other Product Use (IPCC sector 3D1 and 3D3);
- CO_2 emissions from Solvent and Other Product Use (IPCC sector 3D5).

Waste

- Solid waste collection and treatment.

For each of the above-mentioned categories some changes are made and they can be classified in the following groups:

A. Changes in the methodology and methods for process modelling and activities;

B. Changes in the parameters, data and emission factors;

The changes from group A involve change of most of the elements in the processes of calculation, while the changes in group B might be vastly limited.

Solvent and Other Product Use sector

(1) N_2O emissions from Solvent and Other Product Use (IPCC sector 3D1 and 3D3)

In all inventories until 2006 submission, the use of N_2O for anaesthesia sub-category has not been determine due to missing of the appropriate methodology and data. After the in-country review of UNFCCC Secretariat during October 2007, ERT have recommended to use data from Switzerland's methodology for calculation of N_2O emissions from sub-category 3D (without NMVOCs emissions from vegetable oil). The estimates are based on the assumption that 60% of the operations that are reported for Switzerland are carried out in Bulgaria.

As well as N_2O from aerosol cans sub-category, after the ERT's recommendations, Bulgaria made estimates of these emissions that are based on the assumption, that the intensity of using aerosols is the same as in Switzerland (10 grimes per person per year of N_2O emissions).

(2) CO_2 emissions from Solvent and Other Product Use (IPCC sector 3D5)

After the in-country review of UNFCCC Secretariat during October 2007, ERT have recommended determination of CO_2 emissions as a result from converting of NMVOCs emissions in a part of category 3D.

The estimates for CO_2 emissions from pharmacy sub-category where derived based on the conversion of non-methane volatile organic compounds (NMVOCs) applying the Swiss conversion coefficient (2.53 $GgCO_2$/Gg NMVOCs).

The CO_2 emissions estimates from the use of lacquers and solvent sub-category are based on the same conversion coefficient from NMVOCs to CO_2.

Waste sector

During the in-country review of UNFCCC Secretariat during October 2007, were provided values, namely 104.5 m^3 CH_4 per tonne of waste for L_0 and 0.2 per year for "k". The "k" value used is higher than the IPCC default value and higher compared to the values applied in the other Eastern European countries. The ERT considered that the "k" value used is too high, which could lead to an overestimation of the CH_4 emissions from solid waste disposal on land in the base year.

After the in-country review, in response to the ERT request, Bulgaria revised the k value from 0.2 to 0.105, calculated the DOC and L_0 revised the CH_4 estimates from solid waste disposal on land and provided some background documentation

After corrections of the parameters L_o and k, the methane emissions and activity data were recalculated for all years in period 1988-2006.

10.2. Implications for emission levels

Emissions of the above mentioned sources have been recalculated on the basis of the new methodology and emission factors, thus emission data for 1988 to 2005, which are submitted this year differ from data reported previous year.

Table 10.1 Differences between CO_2 (without LUCF) emissions in NIR 2007 and NIR 2008 for 1988-2005 due to recalculation

Year	NIR 2007	NIR 2008	Difference
	Gg CO_2-eq.	Gg CO_2-eq.	%
1988	98 792	98 815	-0.02
1989	99 040	99 063	-0.02
1990	86 246	86 269	-0.03
1991	68 755	68 777	-0.03
1992	61 763	61 785	-0.04
1993	64 354	64 376	-0.03
1994	62 340	62 361	-0.03
1995	66 340	66 361	-0.03
1996	64 988	65 010	-0.03
1997	63 049	63 070	-0.03
1998	55 176	55 197	-0.04
1999	50 968	50 973	-0.01
2000	50 463	50 482	-0.04
2001	52 099	52 105	-0.01
2002	49 257	49 265	-0.02
2003	53 860	53 864	-0.01
2004	53 264	53 270	-0.01
2005	54 978	53 121	3.37

The main reason for the increase of reported CO_2 emissions in 2006 compare to 2005 is the estimates for CO_2 emission in the Solvent and Other Product Use (IPCC sector 3D5) for the first time.

Table 10.2 Differences between CH_4 emissions in NIR 2007 and NIR 2008 for 1988-2005 due to recalculation

Year	NIR 2007	NIR 2008	Difference
	Gg CO_2-eq.	Gg CO_2-eq.	%
1988	21 759	21 685	0.34
1989	21 544	21 493	0.24
1990	19 915	19 947	-0.16
1991	18 522	18 724	-1.09
1992	17 319	17 678	-2.07
1993	15 969	16 494	-3.29
1994	15 015	15 697	-4.54
1995	14 921	15 757	-5.60
1996	14 244	15 242	-7.00
1997	13 269	14 422	-8.69
1998	12 743	14 052	-10.27
1999	11 995	13 396	-11.68
2000	11 708	13 148	-12.30
2001	10 723	12 180	-13.59
2002	10 668	12 118	-13.59
2003	11 335	12 758	-12.56
2004	11 222	12 618	-12.44
2005	10 260	11 666	-13.71

The main reason for the decrease of reported methane emissions in 2006 compare to 2005 is the update of activity data and the new parameters (k and $L_0$0.

Table 10.3 Differences between N_2O emissions in NIR 2007 and NIR 2008 for 1988-2005 due to recalculation

Year	NIR 2007	NIR 2008	Difference
	Gg CO_2-eq.	Gg CO_2-eq.	%
1988	12 061	12 114	-0.44
1989	11 239	11 292	-0.47
1990	1 045	10 501	-0.48
1991	7 793	7 843	-0.65
1992	6 377	6 426	-0.78
1993	5 671	5 720	-0.87
1994	5 805	5 855	-0.86
1995	5 838	5 887	-0.84
1996	5 757	5 806	-0.85
1997	5 404	5 453	-0.91
1998	4 402	4 451	-1.10
1999	4 476	4 524	-1.08
2000	4 918	4 966	-0.99
2001	4 577	4 624	-1.03
2002	4 454	4 500	-1.03
2003	4 446	4 492	-1.04

2004	4 394	4 439	-1.03
2005	4 366	4 411	-1.04

The main reason for the increase of reported N_2O emissions in 2006 compare to 2005 is the estimates for N_2O emission in the Solvent and Other Product Use (IPCC sector 3D1 and 3D3) for the first time.

Reported emissions of F-gases have not been recalculated in submission 2008.

Table 10.4 presents the recalculation differences of national total GHG emissions for all years.

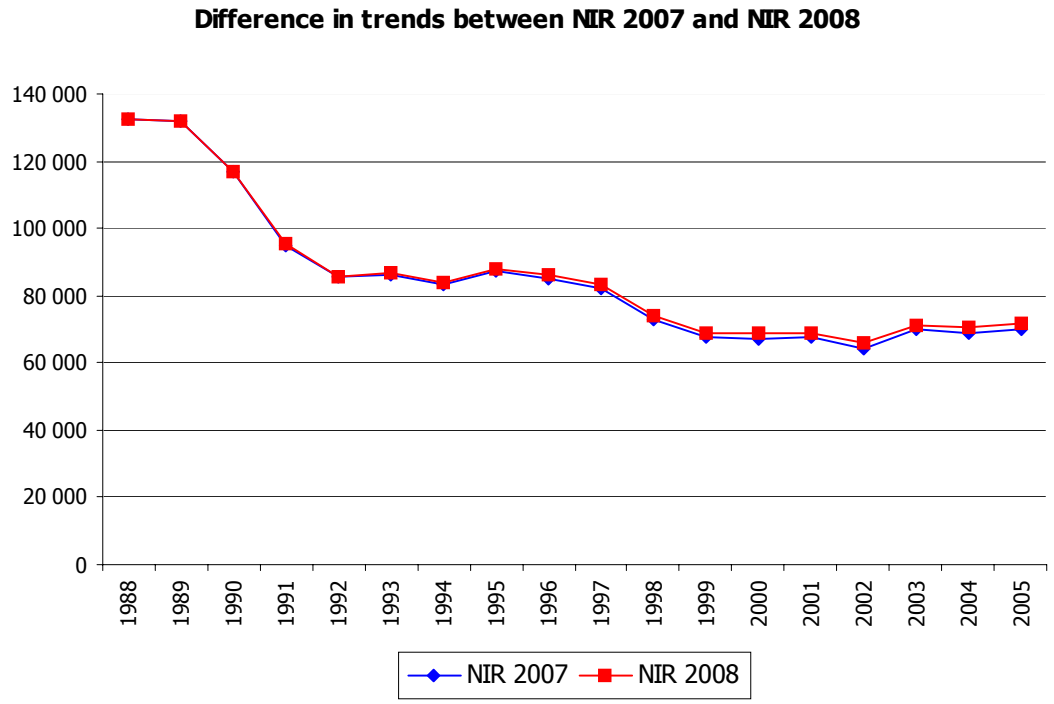
Table 10.4 Differences between NIR 2007 and NIR 2008 for 1988-2005 due to recalculation

Year	NIR 2007	NIR 2008	Difference
	Gg CO_2-eq.	Gg CO_2-eq.	%
1988	132 613	132 614	-0.001
1989	131 823	131 848	-0.019
1990	116 611	116 716	-0.090
1991	95 070	95 344	-0.288
1992	85 459	85 889	-0.503
1993	85 994	86 591	-0.694
1994	83 159	83 913	-0.906
1995	87 102	88 009	-1.042
1996	85 099	86 167	-1.256
1997	81 912	83 136	-1.494
1998	72 900	74 277	-1.889
1999	67 544	68 998	-2.152
2000	67 188	68 695	-2.243
2001	67 499	69 009	-2.238
2002	64 470	65 975	-2.335
2003	69 764	71 237	-2.112
2004	69 100	70 548	-2.096
2005	69 995	70 497	-0.717

10.3 Implications for emission trends

The greenhouse gas emissions in the submission 2008 are slightly different than the emissions reported last year due to recalculation for the base year they are 0.001 % higher and for the year 2005 – 2.01 % higher too.

Figure10.1. Emissions of the submission 2006 and recalculate emissions of the submission 2007



10.4 Plan improvements

The purpose of the Bulgaria's GHG inventory is to fulfill the UNFCCC reporting obligations and the IPCC Guidelines.

The improvements will turn on the following:

(a) Improve the QA/QC system;

(b) Improve the completeness of the GHG inventory by estimating and documenting emissions/removals from land-use change;

(c) Improve the transparency of the estimates in the NIR;

(d) Elaborate the improvement programme, which will be update every year.

REFERENCES

1. The Revised 1996 IPCC guidelines for national greenhouse gas inventory (IPCC Guidelines, 1997);
2. The IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC GPG, 2000);
3. The IPCC good practice guidance for land use, land-use change and forestry (IPCC GPG-LULUCF, 2003)

2. UNFCCC Guidelines on reporting and review, FCCC/CP/1999/7.

3. Fourth National Communication of Bulgaria under UNFCCC, 2002.

4. Second National Action Plan on Climate Change, Sofia, 2004.

ANNEX 1: KEY SOURCES OF GHG EMISSIONS

1.1 Introduction

According to the definition of Good Practice Guidance, key sources of GHG emissions are these sources, which are responsible for 95% of the sum of aggregated GHG emission expressed in CO_2-eq. in the country.

The key sources are defined according to the IPCC classification. It is advisably that the key sources in superior degree are correspondent to the structure of the fuels and the activities in the country.

By method type Tier 1 are defined key sources accounting two rules:

- Rule A – Level assessment of the GHG emissions in absolute value expressed in Gg;

- Rule B – Trend assessment of the emissions from the base year until the current year of the inventory.

By applying rule A is used information for the volume of the source emissions only for the current year of the inventory.

The application of rule B requires information for the GHG emissions for the base year in the country. That means that the trend assessment includes additional information and gives the possibility for thorough analysis of the key sources.

1.2 Tier 1 method for Assessment of Key Sources.

In Table A1.1 presents results from the Level Assessment of the key category analysis excluding LULUCF and Table A1.2 present results from the Trend Assessment of the key category analysis excluding LULUCF. In Table A1.3 presents results from the Level Assessment of the key category analysis including LULUCF and Table A1.4 presents results from the Trend Assessment of the key category analysis including LULUCF.

Table A1.1

Rank	IPCC Source Categories		GHGs	Unit	BY	Level Assessment	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	31317.79	23.63%	23.63%
2	6A	Solid Waste Disposal on Land	CH_4	CO_2-eq.Gg	10587.86	7.99%	31.62%
3	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	9352.86	7.06%	38.67%
4	1A1A	Public Electricity and Heat Production - Liquid fuels	CO_2	Gg	8520.31	6.43%	45.10%
5	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	7740.27	5.84%	50.94%
6	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	7661.43	5.78%	56.72%
7	1A3b	Road Transportation - Gasoline	CO_2	Gg	4562.80	3.44%	60.16%
8	1A4b	Residential - Solid Fuels	CO_2	Gg	4495.56	3.39%	63.55%
9	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	3940.74	2.97%	66.53%
10	1A1A	Public Electricity and Heat Production - Gaseous fuels	CO_2	Gg	3378.80	2.55%	69.07%
11	4D1	Direct soil emissions	N_2O	CO_2-eq.Gg	3273.15	2.47%	71.54%
12	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	3183.96	2.40%	73.95%
13	4D3	Indirect Emissions	N_2O	CO_2-eq.Gg	2824.66	2.13%	76.08%
14	2B2	Nitric Acid Production	N_2O	CO_2-eq.Gg	2421.72	1.83%	77.90%
15	2C1	Iron and Steel	CO_2	Gg	2360.38	1.78%	79.69%
16	4A1	Cattle	CH_4	CO_2-eq.Gg	2248.00	1.70%	81.38%
17	1A4b	Residential - Liquid Fuels	CO_2	Gg	2158.34	1.63%	83.01%
18	2A1	Cement Production	CO_2	Gg	2006.25	1.51%	84.52%
19	1B1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	CO_2-eq.Gg	1991.58	1.50%	86.03%
20	6B	Waste Water Handling	CH_4	CO_2-eq.Gg	1844.93	1.39%	87.42%
21	2B1	Ammonia Production	CO_2	Gg	1662.13	1.25%	88.67%
22	4D2	Pasture. Range and Paddock Manure	N_2O	CO_2-eq.Gg	1652.29	1.25%	89.92%
23	4A3	Sheep	CH_4	CO_2-eq.Gg	1469.57	1.11%	91.03%
24	1B2	Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	CO_2-eq.Gg	1278.97	0.96%	91.99%
25	2A2	Lime Production	CO_2	Gg	1117.84	0.84%	92.83%
26	1A4c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	Gg	1095.09	0.83%	93.66%
27	1A3d	Navigation - Liquid Fuels	CO_2	Gg	1088.46	0.82%	94.48%
28	4B	Manure Management	N_2O	CO_2-eq.Gg	1056.05	0.80%	95.28%

Rank	IPCC Source Categories		GHG	Unit	1995	Level Assessment	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	23465.54	26.67%	26.67%
2	6A	Solid Waste Disposal on Land	CH_4	CO_2-eq.Gg	9860.46	11.21%	37.87%
3	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	8626.63	9.80%	47.68%
4	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	6070.45	6.90%	54.58%
5	1A1A	Public Electricity and Heat Production - Gaseous fuels	CO_2	Gg	3687.47	4.19%	58.77%
6	1A3b	Road Transportation - Gasoline	CO_2	Gg	3414.75	3.88%	62.65%
7	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	3326.11	3.78%	66.43%
8	1A1A	Public Electricity and Heat Production - Liquid fuels	CO_2	Gg	3197.14	3.63%	70.06%
9	1A4b	Residential - Solid Fuels	CO_2	Gg	2256.49	2.56%	72.63%
10	2C1	Iron and Steel	CO_2	Gg	2236.40	2.54%	75.17%
11	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	1974.67	2.24%	77.41%
12	2A1	Cement Production	CO_2	Gg	1925.99	2.19%	79.60%
13	2B2	Nitric Acid Production	N_2O	CO_2-eq.Gg	1921.08	2.18%	81.79%
14	2B1	Ammonia Production	CO_2	Gg	1489.53	1.69%	83.48%
15	1B1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	CO_2-eq.Gg	1453.48	1.65%	85.13%
16	4D1	Direct soil emissions	N_2O	CO_2-eq.Gg	1046.38	1.19%	86.32%
17	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	1037.98	1.18%	87.50%
18	6B	Waste Water Handling	CH_4	CO_2-eq.Gg	1036.24	1.18%	88.68%
19	4D3	Indirect Emissions	N_2O	CO_2-eq.Gg	984.65	1.12%	89.80%
20	4A1	Cattle	CH_4	CO_2-eq.Gg	935.47	1.06%	90.86%
21	4D2	Pasture, Range and Paddock Manure	N_2O	CO_2-eq.Gg	841.24	0.96%	91.81%
22	2A2	Lime Production	CO_2	Gg	747.32	0.85%	92.66%
23	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	Gg	739.37	0.84%	93.50%
24	1B2	Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	CO_2-eq.Gg	652.09	0.74%	94.25%
25	4A3	Sheep	CH_4	CO_2-eq.Gg	569.57	0.65%	94.89%
26	4B	Manure Management	N_2O	CO_2-eq.Gg	495.73	0.56%	95.46%

Rank	IPCC Source Categories		GHG	Unit	2006	Level Assessment	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	25369.35	35.56%	35.56%
2	6A	Solid Waste Disposal on Land	CH_4	CO2-eq.Gg	6847.03	9.60%	45.16%
3	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	4504.10	6.31%	51.47%
4	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	4010.29	5.62%	57.09%
5	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	3267.68	4.58%	61.67%
6	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	2985.92	4.19%	65.86%
7	1A3b	Road Transportation - Gasoline	CO_2	Gg	1919.71	2.69%	68.55%
8	1A1A	Public Electricity and Heat Production - Gaseous fuels	CO_2	Gg	1906.42	2.67%	71.22%
9	2C1	Iron and Steel	CO_2	Gg	1547.98	2.17%	73.39%
10	2A1	Cement Production	CO_2	Gg	1488.39	2.09%	75.48%
11	1A3b	Road Transportation - LPG	CO_2	Gg	1194.66	1.67%	77.15%
12	1B1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	CO2-eq.Gg	1187.03	1.66%	78.81%
13	1A4b	Residential - Solid Fuels	CO_2	Gg	1163.90	1.63%	80.45%
14	4D1	Direct soil emissions	N_2O	CO2-eq.Gg	1039.38	1.46%	81.90%
15	2A2	Lime Production	CO_2	Gg	1038.41	1.46%	83.36%
16	4A1	Cattle	CH_4	CO2-eq.Gg	918.24	1.29%	84.64%
17	2B2	Nitric Acid Production	N_2O	CO2-eq.Gg	899.72	1.26%	85.91%
18	4D3	Indirect Emissions	N_2O	CO2-eq.Gg	818.78	1.15%	87.05%
19	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	787.88	1.10%	88.16%
20	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	Gg	706.64	0.99%	89.15%
21	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	Gg	697.53	0.98%	90.13%
22	2F	ODS substitutes	HFCs	CO2-eq.Gg	610.68	0.86%	90.98%
23	1B2	Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	CO2-eq.Gg	606.08	0.85%	91.83%
24	6B	Waste Water Handling	CH_4	CO2-eq.Gg	577.88	0.81%	92.64%
25	4D2	Pasture, Range and Paddock Manure	N_2O	CO2-eq.Gg	520.47	0.73%	93.37%
26	2B1	Ammonia Production	CO_2	Gg	467.45	0.66%	94.03%
27	4B	Manure Management	N_2O	CO2-eq.Gg	366.25	0.51%	94.54%
28	2A3	Limestone and Dolomite Use	CO_2	Gg	329.47	0.46%	95.00%
29	4A3	Sheep	CH_4	CO2-eq.Gg	271.96	0.38%	95.38%

A1.2

Rank	IPCC Source Categories		GHG	Unit	BY	2006	Level Assessment	Trend Assessment	Contribution to Trend	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	31317.79	25369.35	35.56%	0.439	34.47%	34.47%
2	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	9352.86	4010.29	5.62%	0.131	10.29%	44.76%
3	1A1A	Public Electricity and Heat Production - Liquid fuels	CO_2	Gg	8520.31	149.49	0.21%	0.116	9.07%	53.83%
4	4D1	Direct soil emissions	N_2O	CO2-eq.Gg	3273.15	1039.38	1.46%	0.046	3.60%	57.44%
5	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	3183.96	4504.10	6.31%	0.045	3.50%	60.94%
6	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	3940.74	787.88	1.10%	0.035	2.73%	63.67%
7	1A4b	Residential - Solid Fuels	CO_2	Gg	4495.56	1163.90	1.63%	0.033	2.57%	66.23%
8	1A3b	Road Transportation - LPG	CO_2	Gg	0.73	1194.66	1.67%	0.031	2.44%	68.68%
9	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	7740.27	2985.92	4.19%	0.031	2.41%	71.09%
10	6A	Solid Waste Disposal on Land	CH_4	CO2-eq.Gg	10587.86	6847.03	9.60%	0.030	2.35%	73.44%
11	1A4b	Residential - Liquid Fuels	CO_2	Gg	2158.34	74.34	0.10%	0.028	2.22%	75.66%
12	6B	Waste Water Handling	CH_4	CO2-eq.Gg	1844.93	577.88	0.81%	0.026	2.03%	77.69%
13	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	7661.43	3267.68	4.58%	0.022	1.75%	79.44%
14	4A3	Sheep	CH_4	CO2-eq.Gg	1469.57	271.96	0.38%	0.021	1.62%	81.06%
15	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	Gg	0.00	706.64	0.99%	0.018	1.44%	82.50%
16	4D3	Indirect Emissions	N_2O	CO2-eq.Gg	2824.66	818.78	1.15%	0.018	1.43%	83.94%
17	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO2	Gg	0.00	697.53	0.98%	0.018	1.43%	85.36%
18	2F	ODS substitutes	HFCs	CO2-eq.Gg	0.00	610.68	0.86%	0.016	1.25%	86.61%
19	1A3b	Road Transportation - Gasoline	CO_2	Gg	4562.80	1919.71	2.69%	0.014	1.10%	87.71%
20	1A4c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	Gg	1095.09	117.17	0.16%	0.012	0.97%	88.67%
21	2A2	Lime Production	CO_2	Gg	1117.84	1038.41	1.46%	0.011	0.89%	89.57%
22	2B1	Ammonia Production	CO_2	Gg	1662.13	467.45	0.66%	0.011	0.87%	90.44%
23	2A1	Cement Production	CO_2	Gg	2006.25	1488.39	2.09%	0.011	0.84%	91.28%
24	2B2	Nitric Acid Production	N_2O	CO2-eq.Gg	2421.72	899.72	1.26%	0.011	0.83%	92.10%
25	4D2	Pasture, Range and Paddock Manure	N_2O	CO2-eq.Gg	1652.29	520.47	0.73%	0.010	0.75%	92.86%
26	4A1	Cattle	CH_4	CO2-eq.Gg	2248.00	918.24	1.29%	0.008	0.60%	93.45%
27	1A4a	Commercial/Institutional - Liquid Fuels	CO_2	Gg	524.72	204.94	0.29%	0.007	0.58%	94.03%
28	2C1	Iron and Steel	CO_2	Gg	2360.38	1547.98	2.17%	0.007	0.57%	94.60%

29	4B8	Swine	CH_4	CO2-eq.Gg	851.44	204.23	0.29%	0.007	0.52%	95.12%
30	1A3a	Civil Aviation - Liquid Fuels	CO_2	Gg	611.59	122.10	0.17%	0.005	0.42%	95.54%
31	4B	Manure Management	N_2O	CO2-eq.Gg	1056.05	366.25	0.51%	0.005	0.41%	95.95%

A1.3

Rank	IPCC Source Categories		GHG	Unit	BY	BY	Level Assessment	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	31317.8	31317.8	22.56%	22.56%
2	6A	Solid Waste Disposal on Land	CH_4	CO_2-eq.Gg	10587.9	10587.9	7.63%	30.18%
3	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	9352.9	9352.9	6.74%	36.92%
4	1A1A	Public Electricity and Heat Production - Liquid fuels	CO_2	Gg	8520.3	8520.3	6.14%	43.06%
5	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	7740.3	7740.3	5.58%	48.63%
6	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	7661.4	7661.4	5.52%	54.15%
7	5A1	Forest Land remaining Forest Land	CO_2	Gg	-5132.6	5132.6	3.70%	57.85%
8	1A3b	Road Transportation - Gasoline	CO_2	Gg	4562.8	4562.8	3.29%	61.14%
9	1A4b	Residential - Solid Fuels	CO_2	Gg	4495.6	4495.6	3.24%	64.37%
10	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	3940.7	3940.7	2.84%	67.21%
11	1A1A	Public Electricity and Heat Production - Gaseous fuels	CO_2	Gg	3378.8	3378.8	2.43%	69.65%
12	4D1	Direct soil emissions	N2O	CO_2-eq.Gg	3273.1	3273.1	2.36%	72.00%
13	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	3184.0	3184.0	2.29%	74.30%
14	4D3	Indirect Emissions	N_2O	CO_2-eq.Gg	2824.7	2824.7	2.03%	76.33%
15	2B2	Nitric Acid Production	N_2O	CO_2-eq.Gg	2421.7	2421.7	1.74%	78.08%
16	2C1	Iron and Steel	CO_2	Gg	2360.4	2360.4	1.70%	79.78%
17	4A1	Cattle	CH_4	CO_2-eq.Gg	2248.0	2248.0	1.62%	81.40%
18	1A4b	Residential - Liquid Fuels	CO_2	Gg	2158.3	2158.3	1.55%	82.95%
19	2A1	Cement Production	CO_2	Gg	2006.3	2006.3	1.45%	84.40%
20	1B1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	CO_2-eq.Gg	1991.6	1991.6	1.43%	85.83%
21	6B	Waste Water Handling	CH_4	CO_2-eq.Gg	1844.9	1844.9	1.33%	87.16%
22	2B1	Ammonia Production	CO_2	Gg	1662.1	1662.1	1.20%	88.36%
23	4D2	Pasture, Range and Paddock Manure	N_2O	CO_2-eq.Gg	1652.3	1652.3	1.19%	89.55%
24	4A3	Sheep	CH_4	CO_2-eq.Gg	1469.6	1469.6	1.06%	90.60%
25	1B2	Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	CO_2-eq.Gg	1279.0	1279.0	0.92%	91.53%
26	2A2	Lime Production	CO_2	Gg	1117.8	1117.8	0.81%	92.33%
27	1A4c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	Gg	1095.1	1095.1	0.79%	93.12%
28	1A3d	Navigation - Liquid Fuels	CO_2	Gg	1088.5	1088.5	0.78%	93.90%
29	4B	Manure Management	N_2O	CO_2	1056.0	1056.0	0.76%	94.66%
30	4B8	Swine	CH_4	CO_2	851.4	851.4	0.61%	95.28%

Rank	IPCC Source Categories		GHG	Unit	1995	1995	Level Assessment	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	23465.5	23465.5	24.31%	24.31%
2	6A	Solid Waste Disposal on Land	CH_4	CO_2-eq.Gg	9860.5	9860.5	10.21%	34.52%
3	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	8626.6	8626.6	8.94%	43.46%
4	5A1	Forest Land remaining Forest Land	CO_2	Gg	-7524.5	7524.5	7.79%	51.25%
5	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	6070.5	6070.5	6.29%	57.54%
6	1A1A	Public Electricity and Heat Production - Gaseous fuels	CO_2	Gg	3687.5	3687.5	3.82%	61.36%
7	1A3b	Road Transportation - Gasoline	CO_2	Gg	3414.7	3414.7	3.54%	64.90%
8	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	3326.1	3326.1	3.45%	68.34%
9	1A1A	Public Electricity and Heat Production - Liquid fuels	CO_2	Gg	3197.1	3197.1	3.31%	71.65%
10	1A4b	Residential - Solid Fuels	CO_2	Gg	2256.5	2256.5	2.34%	73.99%
11	2C1	Iron and Steel	CO_2	Gg	2236.4	2236.4	2.32%	76.31%
12	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	1974.7	1974.7	2.05%	78.35%
13	2A1	Cement Production	CO_2	Gg	1926.0	1926.0	2.00%	80.35%
14	2B2	Nitric Acid Production	N_2O	CO_2-eq.Gg	1921.1	1921.1	1.99%	82.34%
15	2B1	Ammonia Production	CO_2	Gg	1489.5	1489.5	1.54%	83.88%
16	1B1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	CO_2-eq.Gg	1453.5	1453.5	1.51%	85.39%
17	4D1	Direct soil emissions	N_2O	CO_2-eq.Gg	1046.4	1046.4	1.08%	86.47%
18	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	1038.0	1038.0	1.08%	87.54%
19	6B	Waste Water Handling	CH_4	CO_2-eq.Gg	1036.2	1036.2	1.07%	88.62%
20	4D3	Indirect Emissions	N_2O	CO_2-eq.Gg	984.7	984.7	1.02%	89.64%
21	4A1	Cattle	CH_4	CO_2-eq.Gg	935.5	935.5	0.97%	90.61%
22	4D2	Pasture. Range and Paddock Manure	N_2O	CO_2-eq.Gg	841.2	841.2	0.87%	91.48%
23	2A2	Lime Production	CO_2	Gg	747.3	747.3	0.77%	92.25%
24	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	Gg	739.4	739.4	0.77%	93.02%
25	1B2	Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	CO_2-eq.Gg	652.1	652.1	0.68%	93.69%
26	5D1	Wetlands remaining Wetlands	CH_4	Gg	602.7	602.7	0.62%	94.32%
27	4A3	Sheep	CH_4	CO_2-eq.Gg	569.6	569.6	0.59%	94.91%
28	4B	Manure Management	N_2O	CO_2-eq.Gg	495.7	495.7	0.51%	95.42%

Rank	IPCC Source Categories		GHG	Unit	2006	2006	Level Assessment	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	25369.35	25 369.3	32.24%	32.24%
2	5A1	Forest Land remaining Forest Land	CO_2	Gg	-6996.037	6 996.0	8.89%	41.13%
3	6A	Solid Waste Disposal on Land	CH_4	CO2-eq.Gg	6847.03	6 847.0	8.70%	49.83%
4	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	4504.102	4 504.1	5.72%	55.56%
5	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	4010.287	4 010.3	5.10%	60.65%
6	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	3267.68	3 267.7	4.15%	64.80%
7	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	2985.923	2 985.9	3.79%	68.60%
8	1A3b	Road Transportation - Gasoline	CO_2	Gg	1919.708	1 919.7	2.44%	71.04%
9	1A1A	Public Electricity and Heat Production - Gaseous fuels	CO_2	Gg	1906.42	1 906.4	2.42%	73.46%
10	2C1	Iron and Steel	CO_2	Gg	1547.985	1 548.0	1.97%	75.43%
11	2A1	Cement Production	CO_2	Gg	1488.39	1 488.4	1.89%	77.32%
12	1A3b	Road Transportation - LPG	CO_2	Gg	1194.656	1 194.7	1.52%	78.84%
13	1B1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	CO2-eq.Gg	1187.025	1 187.0	1.51%	80.35%
14	1A4b	Residential - Solid Fuels	CO_2	Gg	1163.905	1 163.9	1.48%	81.83%
15	4D1	Direct soil emissions	N_2O	CO2-eq.Gg	1039.375	1 039.4	1.32%	83.15%
16	2A2	Lime Production	CO_2	Gg	1038.406	1 038.4	1.32%	84.47%
17	4A1	Cattle	CH_4	CO2-eq.Gg	918.2382	918.2	1.17%	85.63%
18	2B2	Nitric Acid Production	N_2O	CO2-eq.Gg	899.7211	899.7	1.14%	86.78%
19	4D3	Indirect Emissions	N_2O	CO2-eq.Gg	818.7842	818.8	1.04%	87.82%
20	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	787.881	787.9	1.00%	88.82%
21	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	Gg	706.6438	706.6	0.90%	89.72%
22	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	Gg	697.5267	697.5	0.89%	90.60%
23	2F	ODS substitutes	HFCs	CO2-eq.Gg	610.6793	610.7	0.78%	91.38%
24	1B2	Fugitive Emissions from Fuels - Oil and Natiral Gas	CH_4	CO2-eq.Gg	606.0793	606.1	0.77%	92.15%
25	6B	Waste Water Handling	CH_4	CO2-eq.Gg	577.8831	577.9	0.73%	92.88%
26	4D2	Pasture, Range and Paddock Manure	N_2O	CO2-eq.Gg	520.4704	520.5	0.66%	93.55%
27	2B1	Ammonia Production	CO_2	Gg	467.4539	467.5	0.59%	94.14%
28	5B1	Cropland remaining Cropland	CO_2	Gg	-392.1056	392.1	0.50%	94.64%
29	4B	Manure Management	N_2O	CO2-eq.Gg	366.2517	366.3	0.47%	95.10%

A1.4

Rank	IPCC Source Categories		GHG	Unit	BY	2006	2006 ABS	Level Assessment	Trend Assessment	Contribution to Trend	Cumulative Total
1	1A1A	Public Electricity and Heat Production - Solid fuels	CO_2	Gg	31317.79	25369.35	25 369.3	38.11%	0.259	20.73%	20.73%
2	5A1	Forest Land remaining Forest Land	CO_2	Gg	-5132.628	-6996.037	6 996.0	10.51%	0.124	9.93%	30.66%
3	1A1A	Public Electricity and Heat Production - Liquid fuels	CO_2	Gg	8520.307	149.493	149.5	0.22%	0.124	9.89%	40.55%
4	1A3b	Road Transportation - Diesel Oil	CO_2	Gg	3183.961	4504.102	4 504.1	6.77%	0.082	6.54%	47.09%
5	1A3b	Road Transportation - Gasoline	CO_2	Gg	4562.805	1919.708	1 919.7	2.88%	0.069	5.48%	52.57%
6	1A3e	Other Transportation - Liquid Fuels	CO_2	Gg	3940.738	787.881	787.9	1.18%	0.059	4.73%	57.30%
7	4D1	Direct soil emissions	N_2O	CO2-eq.Gg	3273.147	1039.375	1 039.4	1.56%	0.049	3.93%	61.24%
8	6A	Solid Waste Disposal on Land	CH_4	CO2-eq.Gg	10587.86	6847.03	6 847.0	10.29%	0.038	3.03%	64.27%
9	1A3b	Road Transportation - LPG	CO_2	Gg	0.729581	1194.656	1 194.7	1.79%	0.034	2.75%	67.01%
10	1A4b	Residential - Solid Fuels	CO_2	Gg	4495.56	1163.905	1 163.9	1.75%	0.034	2.72%	69.74%
11	1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	Gg	7740.271	2985.923	2 985.9	4.49%	0.030	2.43%	72.17%
12	1A4b	Residential - Liquid Fuels	CO_2	Gg	2158.344	74.3356	74.3	0.11%	0.030	2.42%	74.59%
13	1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	Gg	9352.857	4010.287	4 010.3	6.02%	0.025	2.01%	76.60%
14	1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	Gg	7661.43	3267.68	3 267.7	4.91%	0.021	1.69%	78.29%
15	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	Gg	0	706.6438	706.6	1.06%	0.020	1.63%	79.91%
16	1A1c	Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	Gg	0	697.5267	697.5	1.05%	0.020	1.60%	81.52%
17	4D3	Indirect Emissions	N_2O	CO2-eq.Gg	2824.661	818.7842	818.8	1.23%	0.019	1.51%	83.03%
18	2F	ODS substitutes	HFCs	CO2-eq.Gg	3	610.6793	610.7	0.92%	0.018	1.40%	84.43%
19	4A3	Sheep	CH_4	CO2-eq.Gg	1469.567	271.9639	272.0	0.41%	0.014	1.14%	85.57%
20	1A4c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	Gg	1095.089	117.1702	117.2	0.18%	0.013	1.05%	86.62%
21	2A2	Lime Production	CO_2	Gg	1117.84	1038.406	1 038.4	1.56%	0.013	1.05%	87.66%
22	2A1	Cement Production	CO_2	Gg	2006.253	1488.39	1 488.4	2.24%	0.013	1.01%	88.68%

23	2B1	Ammonia Production	CO_2	Gg	1662.127	467.4539	467.5	0.70%	0.012	0.92%	89.60%
24	6B	Waste Water Handling	CH_4	CO2-eq.Gg	1844.926	577.8831	577.9	0.87%	0.011	0.89%	90.49%
25	2B2	Nitric Acid Production	N_2O	CO2-eq.Gg	2421.72	899.7211	899.7	1.35%	0.011	0.84%	91.33%
26	4D2	Pasture, Range and Paddock Manure	N_2O	CO2-eq.Gg	1652.286	520.4704	520.5	0.78%	0.010	0.79%	92.11%
27	2C1	Iron and Steel	CO_2	Gg	2360.375	1547.985	1 548.0	2.33%	0.009	0.73%	92.84%
28	5D1	Wetlands remaining Wetlands	CO_2	Gg	594.22	602.7133	602.7	0.91%	0.009	0.71%	93.55%
29	4A1	Cattle	CH_4	CO2-eq.Gg	2248	918.2382	918.2	1.38%	0.007	0.59%	94.14%
30	4B8	Swine	CH_4	CO2-eq.Gg	851.4356	204.2341	204.2	0.31%	0.007	0.55%	94.69%
31	2A3	Limestone and Dolomite Use	CO_2	Gg	457.8656	329.4666	329.5	0.49%	0.007	0.55%	95.24%

ANNEX 2: METHODOLOGY AND DATA FOR ASSESSMENT OF CO_2 EMISSIONS FROM FUEL COMBUSTION

CO_2 emissions from fuel combustion are calculated based on statistics for combustible fuels, carbon content of the fuels and the degree of oxidation. The following main categories are defined:

- Stationary combustion of fossil fuels;

- Mobile combustion of fossil fuels;

- Non-energy use of the fuels;

- Waste and biomass combustion.

Stationary Combustion

CO_2 emissions from fuels in electric plants, refineries, large industrial consumers and other sources are determined on the basis of fuel quantities given in the overall energy balance of the country and emissions factors presented in Table A2.1. These factors are aggregated at a level type of fuel. As it is seen from the table, they account also the type of the combustion technology depending on the source.

Table A2.1

Fuels	Carbon content	LCV	EF	EF
	%	GJ/t	kg/t	kg/GJ
Hard coal				
Residential	79	24.0	2 431	101.3
Metal industry	68.5	21.0	2 127	101.3
Public Power Plant	66.6	23.1	2 342	101.4
CHP	65.9	26.0	2 938	113.0
Coke	84	30.0	3 180	106.0
Petroleum Coke	99	31.0	3 193	103.0
Brown Coal				
Public Power Plant	55	12.0	1 141	95.1
CHP	47	9.0	810	90.0
Metal industry	58	18.0	1 721	95.6
Residential	55	18.0	1 721	95.6
Lignite				
Public Power Plant	18	6.5	728	112.0
CHP	25	7.6	760	100.0
Residential	30	10.4	1 147	110.3
Wood, sp. m^3	45	3.8	375	98.7
BKB	62	18.2	1 820	100.0
Gasoline	87	44.0	3 172	72.1
Diesel Oil	87	41.9	3 189	76.1
LPG	82	52.0	3 245	62.4
Gas Oil	87	41.5	3 042	73.3
Residual Fuel Oil	86	39.8	3 049	76.6
Natural Gas, th.nm^3	58	33.5	1 870	55.8
Dry gas		45.0	2 970	66.0
Coke oven gas,		17.6	827	47.0

th.m^3				
Blast furnace gas, th.m^3		3.7	877	237.0

Mobile Combustion

The mobile sources of CO_2 emissions include all types of transport as well as the internal combustion engines used in the agriculture and forestry and construction sector (so-called "off-road" motor vehicles).

The methodology of GHG emission calculation, including the carbon dioxide is based on the method from type Tier 2 which uses the following main data sources:

- Quantities of consumed fuels by types;

- Number, type and size of the motor vehicles;

- Average size of the road distance and the delivered cargoes;

- Differentiated emission factors by kind, type and size of the motor vehicles.

In defining the CO_2 emissions, the emission factors do not depend significantly on the type and the technology of the combustion and in this sense the differentiation of the factors is only by type of fuel. However, regarding the other GHGs the type of the motor vehicle play a main role. The classification of emission factors by types of motor vehicles is given in annex to the National Inventory Report for the year 2004.

CO_2 emissions from international marine and air transport combustion are calculated with the same data and emission factors as for the domestic transport.

Non-energy use of fuels

The application of the Reference Approach for calculation of the national CO_2 emissions includes also a determination of the stored carbon in the products. In this manner is accounted the non-energy use of the fuels as well as their usage as row materials for the production of chemicals.

The share of the carbon stored in products is presented in Table A2.2

The values indicated in the table are standard and are taken from the Revised IPCC Guidance. It is evident from the data in the table that one part of the carbon is emitted in the atmosphere as CO_2 emissions.

CO_2 emissions from non-energy use of fuels are structured in category Manufacturing Industry and Construction at sector Energy.

Table A2.2 Carbon storage fractions for energy carriers used as feedstock

FUEL TYPE	Fraction of carbon stored 2006
Naphtha	0.75
Lubricants	0.50
Bitumen	1.00
Coal Oils and Tars (from Coking Coal)	0.75
Natural Gas	0.33
Gas/Diesel Oil	0.50
LPG	0.80

Gudron	0.85
Other	
Petroleum Coke	0.85
Residual Oil	0.75
Kerosene	0.8
Distillate	1
Turpentine and Solvent gasoline	0.85
Low octane gasoline, refinery gasoline	0.8

Waste and biomass combustion

A practice of waste combustion for energy production is not introduced yet in Bulgaria. The wastes are combusted only for the purpose of their liquidation as emission pollutants and they are not calculated by the IPCC methodology.

Biomass combustion (mainly wood and wooden wastes form felling) for energy production, food preparation and other purposes is a common practice in Bulgaria. The CO_2 emissions from these activities are net emissions and they do not participate in the GHG Inventory. The same is applied to the plant combustible wastes, which are picked up by the people.

Other GHG emissions and GHG precursors are calculating and are including in GHG inventory.

ANNEX 3: METHODOLOGY FOR CALCULATION OF GHG EMISSIONS FOR SOME SOURCES AND SINKS

3.1 Methodology for Calculation of GHG Emissions from Sources in Bulgaria

The GHG emissions from fuel combustion and technological processes are calculated on the basis of combination of specific for the country methodologies and emission factors and such as those given in the IPCC Guidance as standards.

Emissions of carbon dioxide from sources other than fuels

The sources of CO_2 emissions in Bulgaria regardless of fuels are:

- Steel production;
- Cement production;
- Lime production;
- Ammonia production;
- Production and consumption of soda ash;
- Carbide production;
- Consumption of limestone and dolomite;
- Glass production;
- Desulphurization of output gases in thermo-electric power plants;
- Steel, aluminium and Ferroalloys production.

The determination of the emissions from the upper sources is done by the methods of types Tier 1 and Tier 2 (only for cement) according the Good Practice Guidance. The first sulphur purification installation works from the end of the year 2002 at the energy complex MARITZA EAST. The calculation of the emitted CO_2 in the atmosphere is based on an analytic method.

Emissions of methane

Methane emissions from **fuel combustion** represent considerable smaller part from the other emission sources from these type GHG emissions. They stay at the end of the list of non-emission key sources of GHG emissions.

The fugitive emissions of methane from the coal extraction and systems of extraction and transmission/distribution of gas comprise round 2% of the overall emissions in the country. They are a key source.

One of the most considerable sources of methane is the **Agriculture.** The emissions from enteric fermentation and from manure management take up bigger part of these emissions. They are determined by method from type Tier 1 and only for the emissions of cattle and swine manure is applied method from type Tier 2. Most part of the emission factors is taken from the Good Practice Guidance and from the Revised IPCC Guidelines.

Methane emissions from the **deposing of solid waste** are the biggest GHG source in Bulgaria. They comprise 9.6% of the overall emissions in the country for the year 2006.

This inventory applied of the method for their determination from type Tier 2, which meets the requirement of the good practices.

Emissions of nitrogen oxide

N_2O emissions from **fuel combustion** represent small part of the overall emissions from this type GHGs for the year 2006 – around 9.2%. The energy sub-sectors – electricity and heat production emit the major part of them.

Certain quantities of N_2O – 21.3% are emitted from the **technological processes** and more over in production of nitric acid. The sector Solvent and Other Product Use had 1.1% of the overall emissions in the country for the year 2006.

One of the most significant sources of N_2O is the **Agriculture**. The emissions of this sector are 65% from the overall emissions from this type GHG for the year 2006.

The biggest source of N_2O emissions within the sector is the agricultural soils. The parameters and the emission factors that are used for their calculation are taken from the Revised IPCC Guidance.

Emissions of HFCs, PFCs and SF_6

There is no production of F-gases in Bulgaria.

There is an import of substances and products, which contain halocarbons. In this way, only potential emissions of HFCs and some PFCs are determined.

Actual emissions of SF_6 are defined only on the basis of the fugitive emissions from the fulfilled with this gas electric commutation apparatuses. For this purpose the standard method from the Good Practice Guidance is applied.

3.2 Additional Data for the Forest in Bulgaria

Background

The area of the territories and forests from the forestry fund of Bulgaria (forestry fund) in 2006 is 4 076 464 ha, which is 36.4% of the country's territory. The area covered with forests is 3 674 320 ha, which defines 32.1% wooded territories of the country.

The total wooded surface (including pine-scrub) has increased with 100 549 ha as a result of newly arranged forests and the completed forestations. The un-afforested area prepared for forestation as well the forestry pastures have decreased respectively with 9 100 ha and 12 132 ha.

The area of the forests by type of property is distributed according to **Table A3.1** as follows, where data are for 2003:

Table A3.1 Forest Area by type of ownership 2003

Type	Area – ha		%	
	Total	Afforested	From total	From afforested
State	3 195 314	2 797 529	79.6	78.9
Municipal	339 273	304 857	8.4	8.6
Private subjects	376 919	351 381	9.4	9.9
Private law subjects	7 604	6 861	0.2	0.2
Religious organizations	33 666	27 393	0.8	0.8
Others	62 460	59 416	1.6	1.6
Total	**4015236**	**3547456**	**100**	**100**

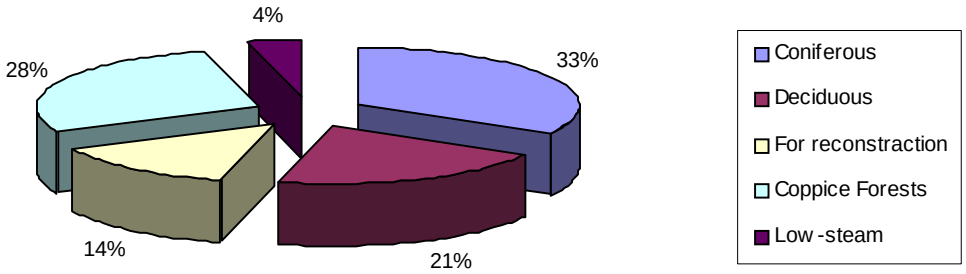
The changes in type of property are expressed in decrease the forests that are state property on the account of the increase in the forests that are municipality's property. These changes are due to the undertaken processes of reinstatement of the forests to the former owners.

The wooden reserve exceeds 598 millions m^3 within average annual increase of around 14.120 millions m^3 and usage of the wood – 7 055 885 m^3.

The distribution of the afforested forestry area by type of woods is presented in **Figure A3.1** in percents.

Figure A3.1

Distribution of the afforested area by type of forest 2003



The area of forests that are mainly kept for timbering and site formation are 65.9%. The forests for recreation and protection occupy 26.6% and the forests and lands at the protective territories – 7.5% from the country's forestry fund.

In the year 2006 have been planted 3.65 millions new forests. 67.7% from them are afforested with deciduous types. The afforested are mainly orientated towards an increase in the afforested area in the country, recuperation of the forests, destroyed by fires, droughts and natural disasters.

EF – ENERGY INDUSTRIES

Electricity Public Generation	Emission Factor						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	2.5	0.1	71	22.3	2.5	0
LPG	0	0	0.6	0	0	0	0
Gas Oil	73.3	7.8	0.4	1432	528	169.6	0.4
Residual Fuel Oil	78.4	3	0.3	242	14.5	3	1.8
Anthracite	101.4	1.5	1.6	571	24.7	1.5	0.81
Black Coal	101.4	1.5	1.6	571	24.7	1.5	0.81
Brown Coal	95.1	1.5	1.6	184	9.3	1.5	2.14
Lignite	112.1	1.5	4,5	147	16.8	1.5	5.49
Coke	106	0	1.6	0	0	0	0.2
Diesel Oil	73.3	7.8	0.4	1432	528	169.6	0.4
BKB	112.1	1.5	4.2	147	16.8	1.5	3.5

Combined Heat & Electricity Public Generation	Emission Factor						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Coke Gas	47.0	1.40	0.1	67.00	17.00	0.00	0.7
Blast Gas	237.0	1.40	0.1	67.00	17.00	0.00	0.7
Natural Gas	55.82	2.5	0.1	60	22.3	2.5	0
LPG	0	0	0.6	0	0	0	0
Gas Oil	73.3	7.8	0.4	1432	528	169.6	0.4
Residual Fuel Oil	74.5	3	0.3	200	14.5	3	1.43
Anthracite	113	1.5	1.6	410	36.3	1.5	1.2
Black Coal	113	1.5	1.6	410	36.3	1.5	1.8
Brown Coal	90	1.5	1.6	157	59.5	1.5	1.62
Lignite	99.9	1.5	4.5	179	16.8	1.5	5.65
Dry gas	66,0	1.4	0.1	67	17	0	0.4
Diesel Oil	73.3	7.8	0.4	1432	528	169.6	0.5
BKB	100	1.5	4.2	179	16.8	1.5	3

Combined Heat & Electricity Auto-generation	Emission Factor						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas 1000 m^3	55.82	2.5	0.1	71.7	22.3	2.5	0
LPG	76	0.03	0.1	103	15	0	0.5
Gas Oil	76	0.03	0.4	103	15	0	0.5
Res. Fuel Oil + Gudron	78.5	3	0.3	134	14.5	3	1.47
Anthracite	113	1.5	1.6	410	36.3	1.5	1.2
Black Coal	113	1.5	1.6	410	36.3	1.5	1.8
Brown Coal	90	1.5	1.6	157	59.5	1.5	1.62
Lignite	99.9	1.5	4.5	179	16.8	1.5	5.65
Coke/Tar	106	1.5	1.6	410	36.3	1.5	0.5
Dry gas	66.0	1.4	0.1	67	17	0	0.4
BKB/ Waste industrial	100	1.5	4.2	179	16.8	1.5	3

Coke Gas	47.0	1.40	0.1	67.00	17.00	0.00	0.7
Blast Gas	237.0	1.40	0.1	67.00	17.00	0.00	0.7
Heat Plants	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	0.1	0.1	54	19	0	0
LPG	0	0	0.1	0	0	0	0
Gas Oil	73.3	2.9	0.4	161	15	0	0.5
Residual Fuel Oil	70	0.7	0.3	139	15	0	1.79
Anthracite	113	15	1.6	410	36.3	15	0
Black Coal	113	15	1.6	410	36.3	15	1.7
Brown Coal	90	15	1.6	157	59.5	15	1.7
Lignite	99.9	15	4.0	179	16.8	15	4
Coke	106	0	1.6	0	0	0	0.4
Wood	98.7	15	1.4	115	1504	0	0
BKB	100	15	4.0	179	16.8	15	3.88

Petroleum Refining	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.4	0.1	67	17	0	0
LPG	62.4	1.4	0.1	67	17	0	0
Gas Oil	73.3	0.6	0.6	64	16	0	0
Residual Fuel Oil / Distillate	76.6	2.9	0.4	161	15	0	0
Anthracite	101.33	2.4	0	329	93	0	0
Black Coal	101.33	2.4	0	329	93	0	0
Brown Coal	95.6	2.5	0	345	98	0	0
Lignite	110.3	2.5	0	345	98	0	0
Coke	106	0	0	0	0	0	0
Dry gas	66.0	1.4	0.1	67	17	0	0.4
BKB	100	11	0	248	205	0	0
Crude oil	1.7	0.07	0	1.5	2.35	15.6	0.0235
Kerosene	70.8	1.9	0	280	116.8	17.4	0.04

Solid Fuels Transformation Coke& BKB & Blast furnace	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	100	0	0	0	0	0	0
LPG	0	0	0	0	0	0	0
Gas Oil	0	0	0	0	0	0	0
Residual Fuel Oil	0	0	0	0	0	0	0
Anthracite	0	0	0	0	0	0	0
Black Coal	0	1	0	35	211	16	0
Brown Coal	0	0	0	0	0	0	0
Lignite	0	0	0	0	0	60	0
Coke	5	5.6	1.6	7.2	3.5	0.31	0.003

Other Energy Industries	Emission Factor						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.4	0.1	67	17	0	0
LPG	62.4	1.4	0	67	17	0	0
Gas Oil (diesel + gas oil)	73.3	0.6	0.6	64	16	0	0.48
Residual Fuel Oil	76.6	2.9	0.4	161	15	0	0.5
Anthracite	101.33	2.4	1.4	329	93	0	1.33
Black Coal	101.33	2.4	1.4	329	93	0	1.33
Brown Coal	95.6	2.5	1.4	345	98	0	2.7
Lignite	110.3	2.5	4.0	345	98	0	3.3
Coke	106	0	1.40	0	0	0	0.58
Coke Gas	47.0	1.40	0.1	67.00	17.00	0.00	0.7
BKB	100	11	1.4	248	205	0	3.88
Blast Gas	237.0	1.40	0.1	67.00	17.00	0.00	0.7
Kerosene	70.78	1.9	0.6	280	116.8	17.4	0.03
Wood	98.7	15	1.4	115	1504	0	0
Dry gas	66.0	1.4	0.1	67	17	0	0.4

EF - MANUFACTURING INDUSTRIES AND CONSTRUCTION

Iron and Steel	Emission Factor						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.40	0.1	67.00	17.00	0.00	0
LPG	62.40	1.40	0.6	67.00	17.00	0.00	0
Gas Oil	73.30	2.90	0.6	161.00	15.00	0.00	0.48
Residual Fuel Oil	76.60	2.90	0.6	161.00	15.00	0.00	1.5
Anthracite	101.30	2.40	1.4	329.0	93.00	0.00	1.1
Black Coal	101.30	2.40	1.4	329.0	93.00	0.00	1.33
Brown Coal	95.60	2.50	1.4	345.00	98.00	0.00	2.5
Lignite	110.30	2.50	1.4	345.00	98.00	0.00	3.8
Coke	106.00	0.00	1.4	0.00	0.00	0.00	0.58
Wood	98.70	15.00	1.4	115.00	1504	0.00	0
BKB	107.50	2.50	1.4	345.00	98.00	0.00	2.9
Coke Gas	47.0	1.40	0.7	67.00	17.00	0.00	0.7
Blast Gas	237.0	1.40	0.7	67.00	17.00	0.00	0.7

Non-ferrous metals	Emission Factor						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.4	0.1	67	17	0	0
LPG	62.4	1.4	0.6	67	17	0	0
Gas Oil	73.3	2.9	0.6	161	15	0	0.48
Residual Fuel Oil	76.6	2.9	0.6	161	15	0	1.5
Anthracite	101.3	2.4	1.4	329	93	0	1.2
Black Coal	101.3	2.4	1.4	329	93	0	1.4
Brown Coal	95.60	2.5	1.4	345	98	0	2.5

Lignite	110.30	2.5	1.4	345	98	0	3.26
Coke	106	0	1.4	0	0	0	0.4
Wood	98.70	15.00	1.4	115.00	1504	0.00	0
BKB	107.5	2.5	1.4	345	98	0	2.8

Chemicals	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.4	0.1	67	17	0	0
LPG	62.4	1.4	0.6	67	17	0	0
Gas Oil	73.3	2.9	0.6	161	15	0	0.48
Residual Fuel Oil	76.6	2.9	0.6	161	15	0	1.5
Anthracite	101.3	2.4	1.4	329	93	0	1.2
Black Coal	101.3	2.4	1.4	329	93	0	1.4
Brown Coal	95.60	2.5	1.4	345	98	0	2.5
Lignite	110.30	2.5	1.4	345	98	0	3.26
Coke	106	0	1.4	0	0	0	0.4
Wood	98.70	15.00	1.4	115.00	1504	0.00	0
BKB	107.5	2.5	1.4	345	98	0	2.8
Jet Gasoline-Non-energy	70.8	58.93	0.6	73.33	23080	535.7	0.045

Pulp, Paper and Printing	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.4	0.1	67	17	0	0
LPG	62.4	1.4	0.6	67	17	0	0
Gas Oil	73.3	2.9	0.6	161	15	0	0.48
Residual Fuel Oil	76.6	2.9	0.6	161	15	0	1.5
Anthracite	101.3	2.4	1.4	329	93	0	1.2
Black Coal	101.3	2.4	1.4	329	93	0	1.4
Brown Coal	95.60	2.5	1.4	345	98	0	2.5
Lignite	110.30	2.5	1.4	345	98	0	3.26
Coke	106	0	1.4	0	0	0	0.4
Wood	98.70	15.00	1.4	115.00	1504	0.00	0
BKB	107.5	2.5	1.4	345	98	0	2.8
Jet Gasoline-No	70.8	58.93	0.6	73.33	23080	535.7	0.045

Food Processing Beverages and Tobacco	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.4	0.1	67	17	0	0
LPG	62.4	1.4	0.6	67	17	0	0
Gas Oil	73.3	2.9	0.6	161	15	0	0.48
Residual Fuel Oil	76.6	2.9	0.6	161	15	0	1.5
Anthracite	101.3	2.4	1.4	329	93	0	1.2
Black Coal	101.3	2.4	1.4	329	93	0	1.4
Brown Coal	95.60	2.5	1.4	345	98	0	2.5

Lignite	110.30	2.5	1.4	345	98	0	3.26
Coke	106	0	1.4	0	0	0	0.4
Wood	98.70	15.00	1.4	115.00	1504	0.00	0
BKB	107.5	2.5	1.4	345	98	0	2.8

Others	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.82	1.4	0.1	67	17	0	0
LPG	62.4	1.4	0.6	67	17	0	0
Gas Oil	73.3	2.9	0.6	161	15	0	0.48
Residual Fuel Oil	76.6	2.9	0.6	161	15	0	1.5
Anthracite	101.3	2.4	1.4	329	93	0	1.2
Black Coal	101.3	2.4	1.4	329	93	0	1.4
Brown Coal	95.60	2.5	1.4	345	98	0	2.5
Lignite	110.30	2.5	1.4	345	98	0	3.26
Coke	106	0	1.4	0	0	0	0.4
Wood	98.70	15.00	1.4	115.00	1504	0.00	0
BKB	107.5	2.5	1.4	345	98	0	2.8
Jet Gasoline-No	70.8	58.93	1.4	73.33	23080	535.7	0.04
Kerosene	70.6	2	0.7	283	116.6	17.5	0.03
Dry gas	66,0	1.4	0.7	67	17	0	0.4
Petroleum Coke	103		0.7				0.4

EF – TRANSPORT

Emission factors for mobile sources, g/kg fuel						
	NOx	**CH_4**	**NMVOC**	**CO**	**N_2O**	**CO_2**
Gasoline						
Pass. cars < 1000 ccm	13.56	2.04	27.6	185.78	0.06	3172
Pass. cars 1000-1500 ccm	15.92	2.04	37.54	287.87	0.06	3172
Pass. cars 1500-2000 ccm	16.51	2.04	43.33	323.55	0.06	3172
Pass. cars > 2000 ccm	15.23	2.04	45.35	390.45	0.06	3172
Busses < 12 p	18.34	2.04	32.64	188.99	0.04	3172
Busses 12 ÷32 p	19.19	1.07	59.72	251.32	0.04	3172
Trucks < 1.5 t	7.79	0.63	23.04	147.86	0.04	3172
Trucks 1.5-5 t	11.67	0.68	34.97	221.41	0.04	3172
Trucks 5-7 t	12.98	0.65	38.12	251.32	0.02	3172
Trucks 7-10 t	10.57	1.02	49.44	264.98	0.02	3172
Motorcycles	2.64	3.75	150	495	0.05	3172
Diesel - road						
Pass. cars < 2000 ccm	8.89	0.09	2.8	10.29	0.08	3188
Pass. cars > 2000 ccm	9.75	0.09	3.59	11.87	0.08	3188
Busses<12p	6.15	0.08	3.29	6.29	0.08	3188
Busses 12 ÷32 p	6.97	0.12	3.93	7.85	0.08	3188
Busses >32 p	11.6	0.16	4.02	11.78	0.08	3188
Long busses (buss + trailer)	12.51	0.28	6.57	14.07	0.08	3188
Trucks < 1.5 t	7.05	0.09	3.74	6.23	0.08	3188
Trucks 1.5-5 t	6.17	0.09	3.99	5.82	0.08	3188

Trucks 5-7 t	7.17	0.1	4.11	7.96	0.08	3188
Trucks 7-10 t	22.79	0.16	4.79	17.3	0.08	3188
Trucks 10-15 t	30	0.21	6.55	20.09	0.08	3188
Trucks > 15 t	42.86	0.26	7.63	21.8	0.08	3188
Diesel off - road						
Farm equipment	63.5	0.45	9.6	25.4	0.08	3188
Construction equipment	50.2	0.18	3.9	16.3	0.08	3188
Water transport	67.5	0.23	4.9	21.3	0.08	3188
Rail transport	74.3	0.25	5.5	26.1	0.08	3188
Piston aircraft	3.52	2.64	24	1034	0.04	3172
Jet aircraft	12.5	0.09	0.78	5.2	0	3149
Ships	87	0	0	1.9	0.08	3212

LPG- benzine						
Pass. cars < 1000 ccm	36.8	0.68	25.7	122	0.12	3286
Pass. cars 1000-1500 ccm	36.8	0.68	25.7	122	0.12	3286
Pass. cars 1500-2000 ccm	36.8	0.68	25.7	122	0.12	3286
Pass. cars > 2000 ccm	36.8	0.68	25.7	122	0.12	3286
Trucks < 1.5 t	27.4	0.45	33.4	341	0.36	3286
Trucks 1.5-5 t	27.4	0.45	33.4	341	0.36	3286
Trucks 5-7 t	33.2	1.25	8	13.9	0.072	3286
Trucks 7-10 t	33.2	1.25	8	13.9	0.072	3286
LPG- diesel						
Pass. cars < 2000 ccm	36	0,68	25	120	0.12	3286
Pass. cars > 2000 ccm	36	0,68	25	120	0.12	3286
Trucks < 1.5 t	26	0.07	3	17	0.06	3286
Trucks 1.5-5 t	26	0.07	3	17	0.06	3286
Trucks 5-7 t	33.2	0.34	8	13.9	0.36	3286
Trucks 7-10 t	33.2	0.34	8	13.9	0.36	3286
Trucks 10-15 t	33.2	0.34	8	13.9	0.36	3286
Trucks > 15 t	33.2	1.02	8	13.9	0.36	3286

EF – OTHER SECTORS

Commercial/ Institutional	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.8	1.2	1.4	48.0	9.6	0.0	0
Kerosene	70.8	1.9	0.6	280.0	116.8	0.0	0.02
Gas Oil	73.3	0.6	0.6	64.0	16.0	0.0	0.48
Residual Fuel Oil	76.6	2.9	0.6	161.0	15.0	0.0	1.50
Anthracite	101.3	10.0	1.4	236.0	195.0	0.0	1.33
Black Coal	101.3	10.0	1.4	236.0	195.0	0.0	1.00

Brown Coal	95.60	11.0	1.4	260.0	214.0	0.0	3.00
Lignite	110.30	11.0	1.4	260.0	214.0	0.0	3.30
Coke	106.0	0.0	1.4	0.0	0.0	0.0	0.50
Wood, Nm^3	90.0	370	4.3	80	1504	0.0	0.00
BKB	100.0	11.0	1.4	248.0	205	0.0	3.50
LPG	62.4	1.1	1.4	47	10	0.0	0.03

Residential	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.8	1.1	0	47.0	10.0	0.0	0
Kerosene	70.8	1.9	1.55	280.0	116.8	0.0	0.03
Gas Oil	73.3	5.0	1.55	51.0	13.0	0.0	0.48
Residual Fuel Oil	76.6	2.9	0.15	161.0	15.0	0.0	1.50
Anthracite	101.3	0.0	1.4	179.0	35.8	0.0	1.70
Black Coal	101.3	0.0	1.4	179.0	35.8	0.0	1.80
Brown Coal	95.60	0.0	1.4	197.0	3938.0	0.0	3.90
Lignite	110.30	0.0	1.4	197.0	3938.0	0.0	4.27
Coke	106.0	0.0	1.4	0.0	0.0	0.0	0.60
Wood, Nm^3	90	210	4.3	80	10000	600	0.00
BKB	100.0	0.0	1.4	188.0	3760	0.0	3.88
Gasoline	68.6	57.0	0.6	76.0	22366.0	519.0	0.02
LPG	62.4	1.1	0.3	47	10	0	0

Agriculture/Forestry	**Emission Factor**						
	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	kg/GJ
Natural Gas	55.8	1.2	1.4	48.0	9.6	0.0	0
Kerosene	70.8	1.9	0.6	280.0	116.8	0.0	0.02
Gas Oil	73.3	0.6	0.6	64.0	16.0	0.0	0.48
Residual Fuel Oil	76.6	1.6	0.6	155.0	17.0	0.0	1.50
Anthracite	101.3	0.0	1.4	179.0	3580	0.0	1.70
Black Coal	101.3	0.0	1.4	179.0	3580	0.0	1.80
Brown Coal	95.60	0.0	1.4	197.0	214.0	0.0	3.80
Lignite	110.30	0.0	1.4	197.0	3938.0	0.0	4.3
Coke	106.0	0.0	1.4	0.0	0.0	0.0	0.60
Wood, Nm^3	90	210	4.3	200.0	15000	600	0.00
BKB	100.0	11.0	1.4	248.0	205	0.0	3.7
Gasoline	68.6	57.0	0.6	76.0	22366.0	519.0	0.02
LPG	62.4	1.4	0.6	67	17	0	0
Diesel oil	73.3	0.6	0.6	64.0	16.0	0.0	0.48
Motor gasoline	0	0	0.6	0	0	0	0.04

EF – FUGITIVE CH_4 EMISSIONS

Fugitive - Coal **EF- m^3 CH_4/t**	
Underground – mining activities	17.50
Underground – post mining activities	2.50
Surface - mining activities	1.20
Surface – post mining activities	0.10

Fugitive – Oil and Gas **EF – kg CH_4/PJ**	
Oil	
Exploration	0
Production	2650
Transport	745
Refining / Storage	745
Distribution of oil products (LPG consumed)	38278
Natural Gas	
Exploration	-
Production Processing	83682
Transmission	44630
Transit	5224
Distribution	4847
Other Leakage	-
at industrial plants and power stations	279500
in residential and commercial sectors	139500
Venting	
Oil	2000
Gas	18000
Combined	-
Flaring	
Oil	9
Gas	329
Combined	-

Other- LPG consumed	kg/t	*2*
Natural Gas - production	10-3 Gg/106m^3	*2.8*
Natural Gas - transit	10-3 Gg/km	*2.5*
Natural Gas - domestic transmit ion	10-3 Gg/km	*2.5*
Natural Gas - domestic distribution	10-3 Gg/km	*0.62*
Natural Gas - production-flaring	10-3 Gg/106m^3	*0.011*
Oil - refined - flaring	kg/t	*0.0004*

EF – INDUSTRIAL PROCESSES

№	Resource type	Units	CO_2	CH_4	N_2O	CO	NOx	NMVOC	SO_2
			kg	kg	kg	kg	kg	kg	kg
1	**Vegetal oils (sunflower, soy, etc)** Sunflower - 15.42.11.40.00 Maize - 15.62.10.50.00	t						18.0	
2	**Food and Drinks**								
	Meat - 15.11.1x.yy.zz Poultry -15.12.1x.yy.zz Fish - 15.20.11.yy.zz	t						0.3	
	Margarine and solid fats - 15.43.10.yy.zz	t						10.0	
	Animal feed - 15.71.1x.yy.zz Pets -15.72.1x.yy.zz	t						1.0	
	Bread - 15.81.11.00.00	t						8.0	
	Cakes and biscuits – 15.82.12.yy.zz 15.82.13.yy.zz 15.81.12.00.00	t						1.0	
	Sugar -15.83.12.yy.zz	t						10.0	
	Coffee roasting – 15.86.11.30.00 15.86.11.50.00	t						0.55	
	High spirits (grapes, cognacs, vodka, whiskey, liqueurs, etc.) - 15.91.10.yy.zz	th.l						0.35	
	Spirit- 15.92.1x.yy.zz	th.l						1.5	
	Wine – white - 15.93.12.11.00 15.93.12.13.00 15.93.12.15.00	th.l						0.0035	
	Whine – red - 15.93.12.17.00 15.93.12.19.00 15.93.12.30.00	th.l						0.008	
	Beer- 15.96.10.00.00	th.l						0.0035	

№	Resource type	Units	CO_2	CH_4	N_2O	CO	NOx	NMVOC	SO_2
			kg	kg	kg	kg	kg	kg	kg
3	**Rice-**	Mha. day		4.14					
4	**Petroleum products (without fuels):**								
	Ethylene 24.14.11.30.00	t		1.0				1.4	
	Propylene 24.14.11.40.00	t						1.4	
	Dychlorethan 24.14.13.53.00	t		0.4				7.3	
	Stirene 24.16.20.50.00	t		4.0				18.0	
	Ethylbenzene 24.14.12.60.00	t						2.0	
	Methanol- 24.14.22.10.00	t		2.0					
	Caprolactam- 24.14.52.70.00	t			NAV			6.5	
	Polystyrene 24.16.2x.yy.zz	t						5.4	
	Polypropylene 24.16.51.30.00	t						12.0	
	Polyethylene 24.16.1x.yy.zz	t						4.0	
	Polyvinylchloride 24.16.3x.yy.zz	t						8.5	
	Lubricants and other mineral oils 23.20.18.yy.zz	t	36.3 kg/GJ						
	Gasoline producing Gasoline	t						0.31	
	Consuming from stations	t						2.88	
5	**Asphalt (oil bitumen) producing** - 26.82.13.00.0	t						27.2	
	asphalt roofing	th. m2						50.0	
6	**Organic chemical processes - (plastic, synthetic resins and glues) -** 24.16.4x.yy.zz	t						7.5	
	Glues use 24.62.10.13.00	t						600	
	Formaldehyde 24.14.61.11.00	t						5.0	
	Phtalic anhydride 24.14.34.33.00	t						6.0	
	Refinery flaring	t				0.012	0.054	0.0016	0.077
7	**Paints and lacquers (dissolved in water and other solvent)** 24.30.11.yy.zz, 24.30.12.yy.zz	t							
	Paints and glue productions 24.30.22.73.00							18	
	Paint use							500	
	Water-soluble paint use - latex							30	
	Use of paints and solvents in households							400	
	Solvents use in metal industry							900	
	Dry cleaning							600	

№	Resource type	Units	CO2	CH4	N2O	CO	NOx	NMVOC	SO2
			kg	kg	kg	kg	kg	kg	kg
8	**Pulp and Paper -** 21.11.1x.yy.zz	t				5.6	1.5	3.7	7.0
9	**Urea –** 24.15.30.13.00	tN+ t		NE					
10	**Sulphur acid** - 24.13.14.33.00	t							17.5
11	**Ammonia -** 24.15.10.75.00	t	1238.2			7.9		4.7	0.03
12	**Nitric acid -** 24.15.10.50.00	t			6.0		15.0		
13	**Nitric fertilizers - base 100 % N** 24.15.30.yy.zz	t		NE					
14	**Carbide -** 24.13.54.50.00	t	2190						1.5
15	**Soda ash** Production- 24.13.33.10.00 Use	t	 97 415						
16	**Lime production** Quick lime production 26.52.10.33.00 Lime use Dolomite production Dolomite use	t	 785 440 910 477						
17	**Cement – total –** 26.51.12.yy.zz Clinker 26.51.11.00.00	t	498.5 520						0.3
18	**Plate glass – base 2 mm** 26.11.11.yy.zz 26.11.11.50.00	t	41					4.5	
19	**Packing glass –** Jars - 26.13.11.10.00 Bottles - 26.13.11.28.00 26.13.11.34.00 Glass fibers - 26.14.11.yy.zz	t	41					4.5	
20	**Glass insulators -** 26.15.25.00.00	t	41					4.5	
21	**Ceramic bricks, tiles and ridge-tiles** - 26.40.11.yy.zz	Th. pieces			NEG				
22	**Sinter (Smelters)** – 13.10.10.50.00	t		0.5					
23	**Coke -** 23.10.10.30.00	t		0.5					
24	**Refinery flaring**	t				0.012	0.054	0.0016	0.077

№	Resource type	Units	CO_2	CH_4	N_2O	CO	NOx	NMVOC	SO_2
			kg	kg	kg	kg	kg	kg	kg
24	**Retort ember -** 23.10.10.70.00	t			NAV				
25	**Ferroalloys (high-carbon)** Pig iron - 27.10.11.yy.zz Ferromanganese with > 2 % C- 27.10.12.00.00	t		0.9		1.33		0.1	1.0
26	**Ferroalloys (low-carbon)** Ferromanganese with < 2 % C - 27.35.11.00.00 Ferrochromium – 27.35.12.00.00 Ferronickel - 27.35.13.00.00 Other ferroalloys - 27.35.20.yy.zz	t	 1600 1300 1400 3500			 1.2	 0.05	 1.7	 0.035
27	**Steel** 27.10.20.yy.zz marten steel electro steel	t	821 1200 50				0.04	0.03	0.045
28	**Chrome, magnesium, nickel** Beryllium, chrome and others.- 27.45.30.55.00 Raw nickel - 27.45.12.30.00 Magnesium - 27.45.30.25.00	t			NE				
29	**Aluminum (secondary, unprocessed)** 27.42.1x.yy.zz	t	0				0	0	0
30	**Lead** 27.43.11.50.00	t			NO				
31	**Zink** 27.43.12.30.00	t			NO				
32	**Refined copper** 27.44.13.30.00	t			NO				
33	**Production and use of halocarbons (HFC and PFC)**	t			NAV				
34	**Production and use of SF6**	t			NAV				
35	**Production of medicines**	g/person						14	

EF - AGRICULTURE

Enteric Fermentation	EF CH_4 (kg/head/yr)
1. Cattle	
Dairy Cattle	81.00
Non-Dairy Cattle	56.00
2. Buffalo	55.00
3. Sheep	8.00
4. Goats	5.00
5. Camels and Llamas	0.00
6. Horses	18.00
7. Mules and Asses	10.00
8. Swine	1.50
9. Poultry	0.01

Manure Management	EF CH_4 (kg/head/yr)
1. Cattle	16.00
Dairy Cattle	18.30
Non-Dairy Cattle	12.21
2. Buffalo	9.00
3. Sheep	0.28
4. Goats	0.18
5. Camels and Llamas	NO
6. Horses	2.08
7. Mules and Asses	1.14
8. Swine	9.95
9. Poultry	0.12

Manure Management	N kg/head/yr
Non-Dairy Cattle	50.0
Dairy Cattle	70.0
Sheep	16.0
Swine	20.0
Poultry	0.6
Other (please specify)	25.0

Animal Waste Management System	N_2O EF_3, kg N_2O - N/kg N excreted
Anaerobic lagoon	0.001
Liquid system	0.001
Solid storage and dry lot	0.020
Other	0.005

Agriculture soils - Direct N_2O Emissions		
EF1	kg N_2O – N/ kg N	0.01
EF2	kg N_2O – N/ ha/yr	8.00
$Frac_{BURN}$	kg N/ kg crop-N	0.1
$Frac_{R}$	kg N/ kg crop-N	0.45
$Frac_{FUEL}$	kg N/ kg N excreted	0.0
$Frac_{GASF}$	kg NH_3 – N+NOx-N/ kg of synthetic fertilizer N applied	0.1
$Frac_{GASM}$	kg NH_3 – N+NOx-N/ kg of N excreted by livestock	0.2
$Frac_{GRAZ}$	Range 45-50 %	43.89% for 2006
$Frac_{NCRBF}$	kg N/ kg of dry biomass	0.030
$Frac_{NCR0}$	kg N/ kg of dry biomass	0.015
EF3	kg N_2O – N/ kg N excreted	
Animal Waste Management System	Daily spread	0.00
	Pasture range and paddock(grazing)	0.02

Agriculture soil - Indirect N_2O Emissions		
EF4 (N deposition)	kg N_2O – N/ kg NH_3 – N and NOx – N emitted	0.01
EF5 (leaching/runoff)	kg N_2O – N/ kg N leaching/runoff	0.025
$Frac_{LEACH}$	kg N/ kg of fertilizer or manure N	0.10
EF6 (sewage)	kg N_2O – N/ kg N sewage-N produced	0.01
$Frac_{NPR}$	kg N/ kg of protein	0.16

Rice Cultivation	With fertilizing	Without fertilizing
	kg/ha/yr	
EF - CH_4	403	162

Agriculture Residue		
	C fraction	N-C ratio
	% dm	
1. Cereals		
Wheat	0.4853	0.0058
Barley	0.4567	0.0094
Maize - corn	0.4709	0.0200
Oats	0.4567	0.0154
Rye	0.4567	0.0102
Rice	0.4144	0.0162
Other (please specify)		
Maize – for fodder	0.4709	0.0200
2. Pulse (1)		
Dry bean	0.45	0.0444
Peas	0.45	0.0316
Soybeans	0.45	0.0511
Other (please specify)		
Lentils	0.45	0.0511
Chick-Peas	0.45	0.0511

3 Tuber and Root		
Potatoes	0.4226	0.0260
Other (please specify)		
4 Sugar Beet	0.4072	0.0246
5 Other (please specify)		
Cotton	0.450	0.018
Sunflower	0.471	0.02
Tobacco	0.471	0.02
Feed beet	0.407	0.0560
Peanut	0.450	0.0236

SOLID WASTE

Fraction dissimilated DOC	per unit	0.6
CH_4 fraction in landfill gas	per unit	0.5
CH_4 recovery	per unit	0
DOC content	per unit	0.175
MCF - managed disposal	per unit	1
MCF – uncontrolled disposal	per unit	0.6

DOMESTIC WASTEWATER

CH_4 recover	0.0	Methane recovered /or flared
BOD - kg/1000 person/yr	18250	
Part of Wastewater -	0.95	
Part of sludge -	0.05	
BO, kg CH_4/kg BOD	0.25	Maximum methane producing capacity
WS, %	25	Fraction of wastewater anaerobicaly treated
SS, %	25	Fraction of sludge anaerobicaly treated
MCF	1.0	Methane conversion factor

INDUSTRIAL WASTEWATER

Branches	**COD**
	kg/l
Iron and Steel	0.001
Non-ferrous Metals	0.001
Fertilizers	0.001
Food & Beverages-	
Beer	0.0029
Wine	0.0015
Meat packing	0.0041
Diary products	0.0027
Sugar	0.0032
Fish processing	0.0025
Oil & Grease	0.0010
Coffee	0.0090
Soft Drinks	0.0020

Other	0.0050
Pulp and Paper	0.0090
Petroleum refining/petrochemicals	0.0010
Textiles	0.0009
Rubber	0.0037
Others	0.0020
Sludge	0.003

EF_{IndWW} (kg CH_4 /kg COD) = 0.0375

ANNEX 4: CO_2 REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH

There is a possibility for comparison and verification of the results with the sectoral approach when it is applied the reference approach for determination of CO_2 emissions from fuel combustion.

First step in the Reference Approach is calculating the gross consumption using the following formula:

Gross consumption = Production + Import – Export – International Bunkers – Provision Change

In the above equation the fuels are taken in natural fuel units (tons, m^3, etc.) from the Energy Balance.

In the second step the determination of CO_2 emissions is applied. In general, the emission factors provided in the Revised IPCC Guidelines are applied.

Third step in this approach is correction of overall CO_2 emissions by excluding emissions from fuels used as feedstock and for non-energy use. In Table A4.1 are presented the CO_2 emissions from the Energy Sector estimated both by the Reference and the Sectoral Approach.

The comparison between the overall emissions in these two approaches varies within 1.4 – 2.3 % for the last five years under GHG inventory.

Main causes for the difference between Reference and Sectoral Approaches

Differences between the two approaches are mainly due to:

- Differences in the methodological approach;

- Different quantities of consumed fuels, including not taking into account the losses during fuel transformation in the sectoral approach;

- Different conversion factors for fuel conversion from natural units to energy units;

- Different emission factors for different combustion technologies used in the sectoral approach;

- Sensibility of the CO_2 emissions to the distribution of the petrol products produced in the refinery and to the carbon content of the crude petrol.

The above factors had dominant additive action in the former inventories. It means that the influence is in one direction, which leads to accumulation of differences. Influence upon differences between the two approaches has also the different emission factors. Since in the case raised the question for CO_2 emissions, these differences are small. Cause for that is the relative independence of this GHG from the technology of fuel combustion.

Table A4.1 Comparison of CO_2 emissions: Reference Approach (RA) versus Sectoral Approach (SA) - NIR 2008, Gg

Method/ Year	Reference Approach				Sectoral Approach				Difference, %			
	Liquid	Solid	Gaseous	TOTAL	Liquid	Solid	Gaseous	TOTAL	Liquid	Solid	Gaseous	TOTAL
1988	34832	44926	11401	91159	33795	45682	11249	90726	3.07	-1.65	1.35	0.48
1989	34055	44926	11401	90382	33015	46239	11535	90789	3.15	-2.84	-1.17	-0.45
1990	28320	40554	12085	80960	26753	39903	12016	78673	5.86	1.63	0.57	2.91
1991	19254	34727	10158	64139	18376	34925	10055	63357	4.77	-0.57	1.03	1.23
1992	15300	32758	8978	57036	14699	33640	8858	57197	4.09	-2.62	1.35	-0.28
1993	18317	34722	8435	61474	15614	35847	8221	59682	17.31	-3.14	2.6	3
1994	16873	31760	8493	57126	14457	34052	8149	56658	16.71	-6.73	4.22	0.83
1995	16634	32835	10293	59763	14645	34709	10022	59376	13.58	-5.4	2.71	0.65
1996	14575	33418	10440	58432	13458	34907	9843	58208	8.3	-4.27	6.06	0.39
1997	12068	34897	8225	55190	11576	36958	8168	56703	4.26	-5.58	0.69	-2.67
1998	11412	32541	7436	51389	12503	31840	6891	51235	-8.73	2.2	7.91	0.3
1999	11742	28693	5978	46413	11909	28943	5898	46750	-1.4	-0.86	1.36	-0.72
2000	10879	28900	6358	46136	10533	29055	6281	45869	3.28	-0.53	1.22	0.58
2001	10683	31564	5905	48152	10484	31315	5687	47486	1.9	0.8	3.82	1.4
2002	11923	28649	5271	45843	10865	29103	5098	45066	9.74	-1.56	3.39	1.72
2003	12198	32151	5475	49825	11747	32138	5295	49180	3.84	0.04	3.4	1.31
2004	11631	31451	5444	48526	11700	31289	5300	48289	-0.59	0.52	2.72	0.49
2005	13227	30560	6178	49966	12250	30711	5960	48921	7.98	-0.49	3.66	2.14
2006	13286	31208	6494	50988	12860	30762	6202	49823	3.31	1.45	4.72	2.34

ANNEX 5: ASSESSMENT OF COMPLETENESS OF INVENTORIES

In the 2006 GHG Inventory are included all the sectors mentioned in the Revised IPCC Guidelines, 1996 with the exception of:

- Actual F – gases emissions from use of aerosol preparations, fire extinguishers, solvents, semiconductor manufacture, etc.;

The emissions mentioned above exist (excepting the ones from aluminum production), but there are no methodologies elaborated yet for quality collection of the input data.

In **Table A5.1** are presented explanations for the used symbols for designation of the type data in the inventory (Table 9 from CRF files).

Table A5.1

Sources and sinks not estimated (NE)			
GHG	**Sector**	**Source/sink category**	**Explanation**
Carbon	5 LULUCF	5.A.2.1 Cropland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.3 Wetlands converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.4 Settlements converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	No AD available
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	No Model available
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	No Model available
Carbon	5 LULUCF	5.B.2.4 Settlements converted to Cropland	No Model available
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	No Model available
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No Model available
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	No Model available
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	No Model available
Carbon	5 LULUCF	5.D.2.2 Cropland converted to Wetlands	No Model available
Carbon	5 LULUCF	5.D.2.3 Grassland converted to Wetlands	No Model available
Carbon	5 LULUCF	5.E.1 Settlements remaining Settlements	No Model available
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	No Model available
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	No Model available
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	No Model available
Carbon	5 LULUCF	Lakes	No Model available
Carbon	5 LULUCF	Reservoars	No Model available
Carbon	5 LULUCF	Rivers	No Model available
Carbon	5 LULUCF	Marshlands	No Model available
Carbon	5 LULUCF	5.A.2.1 Cropland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.3 Wetlands converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.4 Settlements converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	No AD available
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available.
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	No Model available
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	No Model available
Carbon	5 LULUCF	5.B.2.4 Settlements converted to Cropland	No Model available
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	No Model available
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No Model available
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	No Model available
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	No Model available
Carbon	5 LULUCF	5.D.2.2 Cropland converted to Wetlands	No Model available
Carbon	5 LULUCF	5.D.2.3 Grassland converted to Wetlands	No Model available
Carbon	5 LULUCF	5.E.1 Settlements remaining Settlements	No Model available
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	No Model available
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	No Model available
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	No Model available
Carbon	5 LULUCF	5.A.2.1 Cropland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.3 Wetlands converted to Forest Land	No AD available

Carbon	5 LULUCF	5.A.2.4 Settlements converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	No AD available
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.4 Settlements converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	No AD available
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	No AD available
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	No AD available
Carbon	5 LULUCF	5.D.2.2 Cropland converted to Wetlands	No AD available
Carbon	5 LULUCF	5.D.2.3 Grassland converted to Wetlands	No AD available
Carbon	5 LULUCF	5.E.1 Settlements remaining Settlements	No AD available
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	No AD available
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	No AD available
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	No AD available
Carbon	5 LULUCF	Coniferous	No AD available
Carbon	5 LULUCF	Deciduous	No AD available
Carbon	5 LULUCF	Arable land	No AD available
Carbon	5 LULUCF	Fallow land	No AD available
Carbon	5 LULUCF	Permanent cultures	No AD available
Carbon	5 LULUCF	Pastures	No AD available
Carbon	5 LULUCF	Hayfield	No AD available
Carbon	5 LULUCF	Lakes	No AD available
Carbon	5 LULUCF	Reservoars	No AD available
Carbon	5 LULUCF	Rivers	No AD available
Carbon	5 LULUCF	Marshlands	No AD available
Carbon	5 LULUCF	5.D.2.2 Cropland converted to Wetlands	No AD available
Carbon	5 LULUCF	5.D.2.3 Grassland converted to Wetlands	No AD available
Carbon	5 LULUCF	5.E.1 Settlements remaining Settlements	No AD available
Carbon	5 LULUCF	5.E.2.1 Forest Land converted to Settlements	No AD available
Carbon	5 LULUCF	5.F.2.1 Forest Land converted to Other Land	No AD available
Carbon	5 LULUCF	5.F.2.2 Cropland converted to Other Land	No AD available
Carbon	5 LULUCF	Lakes	No AD available
Carbon	5 LULUCF	Reservoars	No AD available
Carbon	5 LULUCF	Rivers	No AD available
Carbon	5 LULUCF	Marshlands	No AD available
Carbon	5 LULUCF	5.A.2.1 Cropland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.3 Wetlands converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.4 Settlements converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	No AD available
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.4 Settlements converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	No AD available
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	No AD available
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	No AD available
Carbon	5 LULUCF	Coniferous	No AD available
Carbon	5 LULUCF	Deciduous	No AD available
Carbon	5 LULUCF	Arable land	No AD available
Carbon	5 LULUCF	Fallow land	No AD available
Carbon	5 LULUCF	Permanent cultures	No AD available
Carbon	5 LULUCF	Pastures	No AD available
Carbon	5 LULUCF	Hayfield	No AD available
Carbon	5 LULUCF	5.A.2.1 Cropland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.2 Grassland converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.3 Wetlands converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.4 Settlements converted to Forest Land	No AD available
Carbon	5 LULUCF	5.A.2.5 Other Land converted to Forest Land	No AD available
Carbon	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available

Carbon	5 LULUCF	5.B.2.2 Grassland converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.4 Settlements converted to Cropland	No AD available
Carbon	5 LULUCF	5.B.2.5 Other Land converted to Cropland	No AD available
Carbon	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
Carbon	5 LULUCF	5.C.2.2 Cropland converted to Grassland	No AD available
Carbon	5 LULUCF	5.C.2.3 Wetlands converted to Grassland	No AD available
Carbon	5 LULUCF	Coniferous	No AD available
Carbon	5 LULUCF	Deciduous	No AD available
Carbon	5 LULUCF	Arable land	No AD available
Carbon	5 LULUCF	Fallow land	No AD available
Carbon	5 LULUCF	Permanent cultures	No AD available
Carbon	5 LULUCF	Pastures	No AD available
Carbon	5 LULUCF	Hayfield	No AD available
CH_4	1 Energy	1.B.1.B Solid Fuel Transformation	No AD available
CH_4	1 Energy	1.B.2.A.1 Exploration	No Methodology and AD available
CH_4	1 Energy	1.B.2.B.1 Exploration	No Methodology and EF available
CH_4	1 Energy	1.B.2.C.1.3 Combined	No AD available
CH_4	1 Energy	1.B.2.C.2.3 Combined	No AD available
CH_4	2 Industrial Processes	Bricks	No EF available
CH_4	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
CH_4	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
CH_4	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
CH_4	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
CH_4	5 LULUCF	5.A.2 Land converted to Forest Land	No AD available
CH_4	5 LULUCF	5.A.2 Land converted to Forest Land	No AD available
CH_4	5 LULUCF	5.B.1 Cropland remaining Cropland	No AD available
CH_4	5 LULUCF	5.B.2 Land converted to Cropland	No AD available
CH_4	5 LULUCF	5.B.2 Land converted to Cropland	No AD available
CH_4	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
CH_4	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
CH_4	5 LULUCF	5.C.1 Grassland remaining Grassland	No AD available
CH_4	5 LULUCF	5.C.1 Grassland remaining Grassland	No AD available
CH_4	5 LULUCF	5.C.2 Land converted to Grassland	No AD available
CH_4	5 LULUCF	5.C.2 Land converted to Grassland	No AD available
CH_4	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
CH_4	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
CH_4	5 LULUCF	5.D.2 Land converted to Wetlands	No AD available
CH_4	5 LULUCF	5.D.2 Land converted to Wetlands	No AD available
CH_4	5 LULUCF	5.E Settlements	No AD available
CH_4	5 LULUCF	5.E.1 Settlements remaining Settlements	No AD available
CH_4	5 LULUCF	5.E.2 Land converted to Settlements	No AD available
CH_4	5 LULUCF	5.F.2 Land converted to Other Land	No AD available
CH_4	5 LULUCF	Forest Land converted to Other Land-Use Categories	No AD available
CH_4	5 LULUCF	Grassland converted to Other Land-Use Categories	No AD available
CH_4	6 Waste	6.A.2.1 deep (>5 m)	No AD available
CH_4	6 Waste	6.A.2.1 deep (>5 m)	No AD available
CH_4	6 Waste	6.A.2.2 shallow (<5 m)	No AD available
CH_4	6 Waste	6.A.2.2 shallow (<5 m)	No AD available
CO_2	1 Energy	1.B.1.A.1.1 Mining Activities	No Methodology and AD available
CO_2	1 Energy	1.B.1.A.1.2 Post-Mining Activities	No Methodology and AD available
CO_2	1 Energy	1.B.1.A.2.1 Mining Activities	No Methodology and AD available
CO_2	1 Energy	1.B.1.A.2.2 Post-Mining Activities	No Methodology and AD available
CO_2	1 Energy	1.B.1.B Solid Fuel Transformation	No AD available
CO_2	1 Energy	1.B.2.A.1 Exploration	No Methodology and AD available
CO_2	1 Energy	1.B.2.A.2 Production	No EF available
CO_2	1 Energy	1.B.2.A.3 Transport	No Methodology and EF available
CO_2	1 Energy	1.B.2.A.4 Refining / Storage	No Methodology and EF available
CO_2	1 Energy	1.B.2.B.1 Exploration	No Methodology and EF available
CO_2	1 Energy	1.B.2.B.2 Production / Processing	No Methodology available

CO_2	1 Energy	1.B.2.B.3 Transmission	No Methodology available
CO_2	1 Energy	1.B.2.B.4 Distribution	No Methodology available
CO_2	1 Energy	1.B.2.B.5.1 at industrial plants and power stations	No Methodology available
CO_2	1 Energy	1.B.2.B.5.2 in residential and commercial sectors	No Methodology available
CO_2	1 Energy	1.B.2.C.1.1 Oil	No Methodology available
CO_2	1 Energy	1.B.2.C.1.2 Gas	No Methodology available
CO_2	1 Energy	1.B.2.C.1.3 Combined	No Methodology and AD available
CO_2	1 Energy	1.B.2.C.2.1 Oil	No Methodology available
CO_2	1 Energy	1.B.2.C.2.2 Gas	No Methodology available
CO_2	1 Energy	1.B.2.C.2.3 Combined	No Methodology and AD available
CO_2	2 Industrial Processes	2.A.5 Asphalt Roofing	No Methodology available
CO_2	2 Industrial Processes	Bricks	No EF available
CO_2	3 Solvent and Other Product Use	3.A Paint Application	No Methodology available
CO_2	3 Solvent and Other Product Use	3.B Degreasing and Dry Cleaning	No Methodology available
CO_2	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
CO_2	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
CO_2	5 LULUCF	5.A.2 Land converted to Forest Land	No AD available
CO_2	5 LULUCF	5.A.2 Land converted to Forest Land	No AD available
CO_2	5 LULUCF	5.B.1 Cropland remaining Cropland	No AD available
CO_2	5 LULUCF	5.B.1 Cropland remaining Cropland	No AD available
CO_2	5 LULUCF	5.B.2 Land converted to Cropland	No AD available
CO_2	5 LULUCF	5.B.2 Land converted to Cropland	No AD available
CO_2	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
CO_2	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
CO_2	5 LULUCF	5.C.1 Grassland remaining Grassland	No AD available
CO_2	5 LULUCF	5.C.1 Grassland remaining Grassland	No AD available
CO_2	5 LULUCF	5.C.2 Land converted to Grassland	No AD available
CO_2	5 LULUCF	5.C.2 Land converted to Grassland	No AD available
CO_2	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
CO_2	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
CO_2	5 LULUCF	5.E Settlements	No AD available
CO_2	5 LULUCF	Forest Land converted to Other Land-Use Categories	No AD available
CO_2	5 LULUCF	Grassland converted to Other Land-Use Categories	No AD available
CO_2	6 Waste	6.A.1 Managed Waste Disposal on Land	No Methodology available
CO_2	6 Waste	6.A.2.1 deep (>5 m)	No AD available
CO_2	6 Waste	6.A.2.2 shallow (<5 m)	No AD available
HFCs	2 Industrial Processes	2.F.1 Refrigeration and Air Conditioning Equipment	No AD available
HFCs	2 Industrial Processes	2.F.2 Foam Blowing	No AD available
HFCs	2 Industrial Processes	2.F.3 Fire Extinguishers	No AD available
HFCs	2 Industrial Processes	2.F.4 Aerosols/ Metered Dose Inhalers	No AD available
HFCs	2 Industrial Processes	2.F.5 Solvents	No AD available
HFCs	2 Industrial Processes	2.F.7 Semiconductor Manufacture	No AD available
HFCs	2 Industrial Processes	2.F.8 Electrical Equipment	No AD available
N_2O	1 Energy	1.B.2.A.1 Exploration	No Methodology and AD available
N_2O	1 Energy	1.B.2.C.2.1 Oil	No Methodology available
N_2O	1 Energy	1.B.2.C.2.2 Gas	No Methodology available
N_2O	1 Energy	1.B.2.C.2.3 Combined	No Methodology and AD available

N_2O	2 Industrial Processes	Bricks	No EF available
N_2O	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
N_2O	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
N_2O	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
N_2O	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
N_2O	5 LULUCF	5.A.1 Forest Land remaining Forest Land	No AD available
N_2O	5 LULUCF	5.A.2 Land converted to Forest Land	No AD available
N_2O	5 LULUCF	5.A.2 Land converted to Forest Land	No AD available
N_2O	5 LULUCF	5.A.2 Land converted to Forest Land	No AD available
N_2O	5 LULUCF	5.B.1 Cropland remaining Cropland	No AD available
N_2O	5 LULUCF	5.B.2 Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2 Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.1 Forest Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.2 Grassland converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.2 Grassland converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.3 Wetlands converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.5 Other Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.B.2.5 Other Land converted to Cropland	No AD available
N_2O	5 LULUCF	5.C.1 Grassland remaining Grassland	No AD available
N_2O	5 LULUCF	5.C.1 Grassland remaining Grassland	No AD available
N_2O	5 LULUCF	5.C.2 Land converted to Grassland	No AD available
N_2O	5 LULUCF	5.C.2 Land converted to Grassland	No AD available
N_2O	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
N_2O	5 LULUCF	5.C.2.1 Forest Land converted to Grassland	No AD available
N_2O	5 LULUCF	5.D.2 Land converted to Wetlands	No AD available
N_2O	5 LULUCF	5.D.2 Land converted to Wetlands	No AD available
N_2O	5 LULUCF	5.E Settlements	No AD available
N_2O	5 LULUCF	5.E.1 Settlements remaining Settlements	No AD available
N_2O	5 LULUCF	5.E.2 Land converted to Settlements	No AD available
N_2O	5 LULUCF	5.F.2 Land converted to Other Land	No AD available
N_2O	5 LULUCF	Forest Land converted to Other Land-Use Categories	No AD available
N_2O	5 LULUCF	Grassland converted to Other Land-Use Categories	No AD available
N_2O	6 Waste	6.B.1 Industrial Wastewater	No Methodology available
N_2O	6 Waste	6.B.1 Industrial Wastewater	No Methodology available
N_2O	6 Waste	6.B.2.1 Domestic and Commercial (w/o human sewage)	No Methodology available
N_2O	6 Waste	6.B.2.1 Domestic and Commercial (w/o human sewage)	No Methodology available
PFCs	2 Industrial Processes	2.F.1 Refrigeration and Air Conditioning Equipment	No AD available
PFCs	2 Industrial Processes	2.F.2 Foam Blowing	No AD available
PFCs	2 Industrial Processes	2.F.3 Fire Extinguishers	No AD available
PFCs	2 Industrial Processes	2.F.4 Aerosols/ Metered Dose Inhalers	No AD available
PFCs	2 Industrial Processes	2.F.5 Solvents	No AD available
PFCs	2 Industrial Processes	2.F.7 Semiconductor Manufacture	No AD available
PFCs	2 Industrial Processes	2.F.8 Electrical Equipment	No AD available
PFCs	2 Industrial Processes	Other non-specified	No AD available
SF_6	2 Industrial Processes	2.F.5 Solvents	No AD available
SF_6	2 Industrial	2.F.8 Electrical Equipment	No AD available

	Processes		
SF_6	2 Industrial Processes	2.F.P2.2 In products	No AD available
SF_6	2 Industrial Processes	Other non-specified	No AD available
Sources and sinks reported elsewhere (IE)			
GHG	**Source/sink category**	**Allocation as per IPCC Guidelines**	**Allocation used by the Party**
CH_4	4.A Enteric Fermentation	4.A	4.A (emissions are included in Goats, Horses, Mules and Asses)
CH_4	4.B Manure Management	4.B	4.B (emissions are included in Goats, Horses, Mules and Asses)
CH_4	5.B.1 Cropland remaining Cropland	4.F	4.F (Biomass burning on cropland remaining cropland is reported in the Agriculture sector)
CO_2	5.B.1 Cropland remaining Cropland	4.F	4.F (Biomass burning on cropland remaining cropland is reported in the Agriculture sector)
N_2O	5.B.1 Cropland remaining Cropland	4.F	4.F (Biomass burning on cropland remaining cropland is reported in the Agriculture sector)

ANNEX 6: ADDITIONAL INFORMATION TO BE CONSIDERED AS PART OF NIR SUBMISSION

Additional information regarding GHG Inventories in Bulgaria can be found in the following publications and works:

1. Fourth National Communication on Climate Change under UNFCCC, 2006.

2. Methodology for the calculation, with balance methods, of the emissions of harmful substances (pollutants), emitted in the ambient air, Sofia, 2006.

3. Second National Action Plan on Climate Change of Bulgaria under UNFCCC, Sofia, 2004.

ANNEX 7: OTHER TABLES

In this Annex 7 presents the Tables 6.1 from the IPCC Good Practice Guidelines: Tier 1 Uncertainty Calculation and Reporting.

IPCC Source category		Gas	Base year emissions	Year 2006 emissions	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2006	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty
			Input data	Input data	Input data	Input data			Note B		Note C	Note D			
			Gg CO_2 equivalent		%	%	%	%	%	%	%	%	%		
3A-D	Solvent and Other Product Use	CO_2	23.05	10.17	10	30	31.6	0.00	-0.00	0.00	-0.0005	0.0011	0.00	1	0
3A-D	Solvent and Other Product Use	N_2O	52.93	45.23	100	0	100.0	0.06	0.00	0.00	-	0.0483	0.05	1	0
1A1	Energy Industries	CH_4	17.73	9.54	5	50	50.2	0.01	-0.00	0.00	-0.0000	0.0005	0.00	1	0
1A1	Energy Industries	N_2O	302.11	250.54	5	200	200.1	0.70	0.00	0.00	0.1327	0.0134	0.13	1	0
1A1.A	Public Electricity and Heat Production - Gaseous fuels	CO_2	3378.80	1906.42	5	5	7.1	0.19	0.00	0.01	0.0033	0.1017	0.10	1	0
1A1.A	Public Electricity and Heat Production - Liquid fuels	CO_2	8520.31	149.49	5	5	7.1	0.01	-0.03	0.00	-0.1672	0.0080	0.17	1	0
1A1.A	Public Electricity and Heat Production - Solid fuels	CO_2	31317.79	25369.35	5	7	8.6	3.06	0.06	0.19	0.4485	1.3534	1.43	1	0
1A1.B	Petroleum Refining - Gaseous fuels	CO_2	0.00	50.63	5	5	7.1	0.01	0.00	0.00	0.0019	0.0027	0.00	1	0
1A1.B	Petroleum Refining - Liquid fuels	CO_2	0.00	0.00	5	5	7.1	0.00	-	0.00	-	-	0.00	1	0
1A1.c	Manufacture of Solid Fuels and Other Energy Industries - Gaseous Fuels	CO_2	0.00	697.53	5	5	7.1	0.07	0.01	0.01	0.0263	0.0372	0.05	1	0
1A1.c	Manufacture of Solid Fuels and Other Energy Industries - Liquid Fuels	CO_2	0.00	706.64	5	5	7.1	0.07	0.01	0.01	0.0267	0.0377	0.05	1	0
1A1.c	Manufacture of Solid Fuels and Other Energy Industries - Solid Fuels	CO_2	0.00	160.62	5	7	8.6	0.02	0.00	0.00	0.0085	0.0086	0.01	1	0

1A2	Manufacturing Industries and Construction - Gaseous Fuels	CO_2	7661.43	3267.68	5	5	7.1	0.32	-0.01	0.02	-0.0323	0.1743	0.18	1	0
1A2	Manufacturing Industries and Construction - Liquid Fuels	CO_2	7740.27	2985.92	5	5	7.1	0.30	-0.01	0.02	-0.0445	0.1593	0.17	1	0
1A2	Manufacturing Industries and Construction - Solid Fuels	CO_2	9352.86	4010.29	5	7	8.6	0.48	-0.01	0.03	-0.0540	0.2139	0.22	1	0
1A2	Manufacturing Industries and Construction	CH_4	11.91	4.79	5	50	50.2	0.00	-0.00	0.00	-0.0006	0.0003	0.00	1	0
1A2	Manufacturing Industries and Construction	N_2O	44.90	18.94	5	200	200.1	0.05	-0.00	0.00	-0.0079	0.0010	0.01	1	0
1A3a	Civil Aviation - Liquid Fuels	CO_2	611.59	122.10	5	5	7.1	0.01	-0.00	0.00	-0.0078	0.0065	0.01	1	0
1A3a	Civil Aviation - Liquid Fuels	CH_4	1.31	0.09	3	40	40.1	0.00	-0.00	0.00	-0.0002	0.0000	0.00	1	0
1A3a	Civil Aviation - Liquid Fuels	N_2O	0.22	0.00	3	40	40.1	0.00	-0.00	0.00	-0.0000	0.0000	0.00	1	0
1A3b	Road Transportation - Diesel Oil	CO_2	3183.96	4504.10	3	5	5.8	0.37	0.02	0.03	0.1052	0.1442	0.18	1	0
1A3b	Road Transportation - Gasoline	CO_2	4562.80	1919.71	3	5	5.8	0.16	-0.00	0.01	-0.0202	0.0614	0.06	1	0
1A3b	Road Transportation - Liquid Fuels	CH_4	53.52	30.04696	3	40	40.1	0.02	0.00	0.00	0.0004	0.0010	0.00	1	0
1A3b	Road Transportation - Liquid Fuels	N_2O	48.28	58.32	3	40	40.1	0.03	0.00	0.00	0.0098	0.0019	0.01	1	0
1A3b	Road Transportation - LPG	CO_2	0.73	1194.66	3	5	5.8	0.10	0.01	0.01	0.0450	0.0382	0.06	1	0
1A3c	Railways - liquid fuels	CO_2	368.04	93.12	5	5	7.1	0.01	-0.00	0.00	-0.0040	0.0050	0.01	1	0
1A3c	Railways - liquid fuels	CH_4	0.57	0.153353	5	100	100.1	0.00	-0.00	0.00	-0.0001	0.0000	0.00	1	0
1A3c	Railways - liquid fuels	N2O	2.86	0.724408	5	150	150.1	0.00	-0.00	0.00	-0.0009	0.0000	0.00	1	0
1A3d	Navigation - Liquid Fuels	CO_2	1088.46	0.00	50	5	50.2	0.00	-0.00	0.00	-0.0221	-	0.02	1	0
1A3d	Navigation - Liquid Fuels	CH_4	1.75	0.00	50	50	70.7	0.00	-0.00	0.00	-0.0004	-	0.00	1	0
1A3d	Navigation - Liquid Fuels	N2O	8.47	0.00	50	100	111.8	0.00	-0.00	0.00	-0.0034	-	0.00	1	0
1A3e	Other Transportation - Liquid Fuels	CO_2	3940.74	787.881	5	5	7.1	0.08	-0.01	0.01	-0.0503	0.0420	0.07	1	0
1A3e	Other Transportation - Liquid Fuels	CH_4	5.32	2.138965	5	100	100.1	0.00	-0.00	0.00	-0.0005	0.0001	0.00	1	0

1A3e	Other Transportation - Liquid Fuels	N_2O	29.91	6.129062	5	150	150.1	0.01	-0.00	0.00	-0.0113	0.0003	0.01	1	0
1A4	Other sectors	CH_4	34.81	124.1224	5	50	50.2	0.09	0.00	0.00	0.0398	0.0066	0.04	1	0
1A4	Other sectors	N_2O	49.41	44.56284	5	200	200.1	0.12	0.00	0.00	0.0271	0.0024	0.03	1	0
1A4a	Commercial/Institutional - Gaseous Fuels	CO_2	197.23	147.20	5	5	7.1	0.01	0.00	0.00	0.0015	0.0079	0.01	1	0
1A4a	Commercial/Institutional - Liquid Fuels	CO_2	524.72	204.94	5	5	7.1	0.02	-0.00	0.00	-0.0029	0.0109	0.01	1	0
1A4a	Commercial/Institutional - Solid Fuels	CO_2	345.59	30.61	5	7	8.6	0.00	-0.00	0.00	-0.0082	0.0016	0.01	1	0
1A4b	Residential - Liquid Fuels	CO_2	2158.34	74.34	5	5	7.1	0.01	-0.01	0.00	-0.0410	0.0040	0.04	1	0
1A4b	Residential - Solid Fuels	CO_2	4495.56	1163.90	5	7	8.6	0.14	-0.01	0.01	-0.0663	0.0621	0.09	1	0
1A4b	Residential - Gaseous Fuels	CO_2	0.00	57.2508	5	7	8.6	0.01	0.00	0.00	0.0030	0.0031	0.00	1	0
1A4c	Agriculture/Forestry/Fisheries - Gaseous Fuels	CO_2	11.44	74.88	5	5	7.1	0.01	0.00	0.00	0.0026	0.0040	0.00	1	0
1A4c	Agriculture/Forestry/Fisheries - Liquid Fuels	CO_2	1095.09	117.1702	5	5	7.1	0.01	-0.00	0.00	-0.0178	0.0063	0.02	1	0
1A4c	Agriculture/Forestry/Fisheries - Solid Fuels	CO_2	112.27	26.96	5	7	8.6	0.00	-0.00	0.00	-0.0018	0.0014	0.00	1	0
1A5a	Stationary - Biomass	CH_4	35.13	28.79	5	20	20.6	0.01	0.00	0.00	0.0015	0.0015	0.00	1	0
1A5a	Stationary - Biomass	N_2O	10.62	8.70	5	20	20.6	0.00	0.00	0.00	0.0005	0.0005	0.00	1	0
1A5a	Stationary	CO_2	0.00	0.00	5	5	7.1	0.00	-	0.00	-	-	0.00	1	0
1B1	Fugitive Emissions from Fuels - Solid Fuels	CH_4	1991.58	1187.03	10	200	200.2	3.33	0.00	0.01	0.1736	0.1266	0.21	1	0
1B2	Fugitive Emissions from Fuels - Oil and Natural Gas	CH_4	1278.97	606.08	5	50	50.2	0.43	-0.00	0.00	-0.0310	0.0323	0.04	1	0
2A1	Cement Production	CO_2	2006.25	1488.39	3	30	30.1	0.63	0.00	0.01	0.0925	0.0476	0.10	1	0
2A2	Lime Production	CO_2	1117.84	1038.41	5	15	15.8	0.23	0.00	0.01	0.0494	0.0554	0.07	1	0
2A3	Limestone and Dolomite Use	CO_2	457.87	329.47	5	15	15.8	0.07	0.00	0.00	0.0094	0.0176	0.02	1	0
2A4	Soda Ash Production and Use	CO_2	233.19	163.08	5	20	20.6	0.05	0.00	0.00	0.0057	0.0087	0.01	1	0

2A7	Other	CO_2	26.61	131.81	5	20	20.6	0.04	0.00	0.00	0.0177	0.0070	0.02	1	0
2B1	Ammonia Production	CO_2	1662.13	467.45	5	20	20.6	0.14	-0.00	0.00	-0.0644	0.0249	0.07	1	0
2B2	Nitric Acid Production	N_2O	2421.72	899.72	10	200	200.2	2.53	-0.00	0.01	-0.6091	0.0960	0.62	1	0
2B4.2	Calcium Carbide	CO_2	89.32	23.05	5	20	20.6	0.01	-0.00	0.00	-0.0038	0.0012	0.00	1	0
2B5	Other	CH_4	0.84	2.74	5	50	50.2	0.00	0.00	0.00	0.0009	0.0001	0.00	1	0
2C	Metal Production	CH_4	73.20	41.84	5	20	20.6	0.01	0.00	0.00	0.0004	0.0022	0.00	1	0
2C1	Iron and Steel Production	CO_2	2360.38	1547.98	3	10	10.4	0.23	0.00	0.01	0.0209	0.0495	0.05	1	0
2C2	Ferroalloys Production	CO_2	112.80	44.03	5	25	25.5	0.02	-0.00	0.00	-0.0031	0.0023	0.00	1	0
2F	ODS substitutes	HFCs	2.95	610.68	10	50	51.0	0.44	0.00	0.00	0.2298	0.0652	0.24	1	0
2F8	Electrical Equipment	SF_6	1.26	5.30	10	50	51.0	0.00	0.00	0.00	0.0017	0.0006	0.00	1	0
2G	Other	CH_4	7.62	0.00	10	50	51.0	0.00	-0.00	0.00	-0.0015	-	0.00	1	0
4A.2	Buffalo	CH_4	27.60	9.50	2	50	50.0	0.01	-0.00	0.00	-0.0020	0.0002	0.00	1	0
4A.3	Sheep	CH_4	1469.57	271.96	2	50	50.0	0.19	-0.00	0.00	-0.1958	0.0058	0.20	1	0
4A.4	Goats	CH_4	45.36	60.77	2	50	50.0	0.04	0.00	0.00	0.0137	0.0013	0.01	1	0
4A.6	Horses	CH_4	46.27	79.88	2	50	50.0	0.06	0.00	0.00	0.0207	0.0017	0.02	1	0
4A.7	Mules and Asses	CH_4	74.61	38.66	2	50	50.0	0.03	-0.00	0.00	-0.0006	0.0008	0.00	1	0
4A.8	Swine	CH_4	128.41	30.80	2	50	50.0	0.02	-0.00	0.00	-0.0145	0.0007	0.01	1	0
4A.9	Poultry	CH_4	8.74	4.17	2	50	50.0	0.00	-0.00	0.00	-0.0002	0.0001	0.00	1	0
4A1	Cattle	CH_4	2248.00	918.24	2	50	50.0	0.64	-0.00	0.01	-0.1100	0.0196	0.11	1	0
4B	N2O emission from Manure Management	N_2O	1056.05	366.25	2	300	300.0	1.54	-0.00	0.00	-0.4575	0.0078	0.46	1	0
4B.2	Buffalo	CH_4	4.52	1.55	2	50	50.0	0.00	-0.00	0.00	-0.0003	0.0000	0.00	1	0

4B.3	Sheep	CH_4	51.43	9.52	2	50	50.0	0.01	-0.00	0.00	-0.0069	0.0002	0.01	1	0
4B.4	Coats	CH_4	1.63	2.19	2	50	50.0	0.00	0.00	0.00	0.0005	0.0000	0.00	1	0
4B.6	Horses	CH_4	5.35	9.23	2	50	50.0	0.01	0.00	0.00	0.0024	0.0002	0.00	1	0
4B.7	Mules and Asses	CH_4	8.51	4.41	2	50	50.0	0.00	-0.00	0.00	-0.0001	0.0001	0.00	1	0
4B.8	Swine	CH_4	851.44	204.23	2	50	50.0	0.14	-0.00	0.00	-0.0958	0.0044	0.10	1	0
4B.9	Poultry	CH_4	102.25	48.74	2	50	50.0	0.03	-0.00	0.00	-0.0024	0.0010	0.00	1	0
4B1	Cattle	CH_4	498.52	204.87	2	50	50.0	0.14	-0.00	0.00	-0.0239	0.0044	0.02	1	0
4C	Rice Cultivation	CH_4	119.25	42.98	25	80	83.8	0.05	-0.00	0.00	-0.0128	0.0115	0.02	1	0
4D1	Direct soil emissions	N_2O	3273.15	1039.38	3	250	250.0	3.64	-0.01	0.01	-1.3621	0.0333	1.36	1	0
4D2	Pasture, Range and Paddock Manure	N_2O	1652.29	520.47	3	250	250.0	1.82	-0.00	0.00	-0.6956	0.0167	0.70	1	0
4D3	Indirect Emissions	N_2O	2824.66	818.78	3	500	500.0	5.74	-0.01	0.01	-2.6458	0.0262	2.65	1	0
4F	Field Burning	CH_4	46.35	26.13	25	50	55.9	0.02	0.00	0.00	0.0004	0.0070	0.01	1	0
4F	Field Burning	N_2O	15.10	7.36	25	200	201.6	0.02	-0.00	0.00	-0.0011	0.0020	0.00	1	0
6A	Solid Waste Disposal on Land	CH_4	10587.86	6847.03	20	100	102.0	9.79	0.01	0.05	0.8656	1.4611	1.70	1	0
6B	Waste Water Handling	CH_4	1844.93	577.88	30	80	85.4	0.69	-0.00	0.00	-0.2505	0.1850	0.31	1	0
6B	Waste Water Handling	N_2O	310.49	144.89	30	100	104.4	0.21	-0.00	0.00	-0.0168	0.0464	0.05	1	0
	National Total		**132549.67**	**71 342.59**				**13.33**					**3.92**		